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THE ROMANCE OF
THE AUSTRALIAN LAND INDUSTRIES

SYDNEY COVE, 1788

SYDNEY COVE, 1951

The growth of Australia's fine cities would have been impossible without the development of the land industries.

THE ROMANCE OF THE AUSTRALIAN LAND INDUSTRIES

BY

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FOREWORD

The rural industries in Australia are attracting a great deal of attention at the present time, partly because of the need to increase out exports and partly because of the serious position of the world's present and prospective food supply. Much can be learned from the past and if this little volume should serve to stimulate thought and action in the direction of increasing production at a more rapid rate than during the last few years it will have served a useful purpose.

It does not profess to have any special merit as an historical treatise, but merely aims at telling in simple language something of the interesting story of the progress of the pastoral, agricultural, dairying and allied industries. It is therefore hoped that it will interest the general public just as much as the agricultural student.

Tables of statistics have been reduced to the minimum required to emphasize the main points. The source of a good deal of the information will be obvious from the context, but in order to make it a straightforward story, the author has avoided burdening the reader with a cumbersome list of references. Several hundreds of documents of various kinds have been consulted, and a complete annotated list of them would occupy almost as much space as the letterpress. Most of them are to be found in the Mitchell Library. Some parts of the story have already been so well told by Roberts, Austin and Laffer that somewhat free use has been made of their findings in parts of Chapters 6, 9 and 18 respectively whilst Emeritus Professor J. D. Stewart has been helpful in directing attention to literature dealing with veterinary matters.

The author makes no apology for what may seem the undue prominence he has given to scientific research and its applications. He yields to no one, however, in his admiration for the courage and resourcefulness of the pioneers and leaders of the various industries and for the persistent and strenuous endeavours, in spite of many difficulties, hardships and disappointments, of the individual land-holders who have actually produced the goods. He has considered it advisable to avoid as far as possible

mentioning by name any benefactors of the rural industries who are still alive.

It should be obvious from this historical review that still greater encouragement should be given to every form of agricultural research and education and that it would be advantageous if still more of our best engineers could be directed into avenues which would be of direct benefit to primary production. If these objectives could be attained and supplemented by the recapturing of the spirit, energy and initiative of the pioneers on the part of a larger proportion of the men on the land, there is no reason why the progress of the land industries of the Commonwealth should not continue at an ever-increasing rate.

R.D.W.

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MAPS

Acknowledgment for maps is gratefully made to the Rural Bank of New South Wales.

ERRATA

Page 18, *line* 3: for "£14" read "£4".

" 82, " 21: for "for other purposes for agriculture" read "for agriculture for other purposes".

" 113, " 19: for "Caworro" read "Cawarra".

" 223, " 2: for "it was as 23.4" read "it was as high as 23.4".

THE ROMANCE OF
THE AUSTRALIAN LAND INDUSTRIES

PART I

1788-1900

CHAPTER I

An Unpromising Start

AT brief intervals during January 1788 there arrived in Botany Bay, a few miles to the south of Sydney, one of the most extraordinary expeditionary forces which had ever set sail on the high seas. It consisted of six transports and three store-ships carrying 720 convicts and 443 free men sent out with the enterprise and audacity characteristic of the British race to found a penal settlement on a remote and little-known island more than half the size of Europe.

Captain Arthur Phillip, who was in charge, after a perilous eight-month voyage, was not very favourably impressed by Botany Bay with its shallow exposed harbour and before disembarking he went a little bit north to explore Port Jackson, the entrance to which had been noted on Captain Cook's chart. It can be readily imagined how he felt when he entered the port and saw the azure waters of its innumerable bays and inlets hedged in by beautiful tree-clad slopes. "We got into Port Jackson early in the afternoon," he wrote to Lord Sydney, "and had the satisfaction of finding the finest harbour in the world, in which a thousand sail of the line may ride in the most perfect security." Most of the inlets were examined in order to find the most suitable place for a settlement and finally one was selected which, in Phillip's own words, "had the best spring of water and in which ships can anchor so close to the shores that, at very small expense, quays can be made at which the largest ships may unload." This was at first called Sydney Cove and afterwards Circular Quay, right at the heart of the present city of Sydney and the starting point of most of the ferry services up to the present day. He soon returned to Botany Bay, which Captain Cook and Sir Joseph Banks had recommended as the site for the settlement, and directed all the vessels to make for Sydney Cove.

Besides taking possession of an area of land which might be occupied by some rival nation the main objects of the British government were "the removal of a section of the community which had come into conflict with the laws of the land to such

a distance that there was little chance of their returning and the hope of their reformation when separated from their former environment and associates".

Another important consideration, however, was that expense might be saved through the new Colony becoming self-supporting from the development of its agricultural and pastoral resources. Evidently Sir Joseph Banks, who had accompanied Captain Cook on his previous voyage of discovery and had been the main advocate of the Colony's foundation, was of that opinion; for, to quote his own words, "from the fertility of the soil they (the colonists) might be able to maintain themselves after the first year with little or no aid from the mother country." But it is doubtful if even the most enlightened statesman of the day ever imagined that in little more than a century and a half the distant island of the southern seas would be supporting a population of eight million people and sending its surplus products to every quarter of the globe.

The store-ships had on board sufficient supplies to keep the settlement going for two years, after which it was considered that an occasional supply of food and clothing from Britain would be adequate to supplement the products which the convicts and free men could raise from the soil.

But how was the expedition equipped for the carrying out of the latter important purpose?

They seem to have brought nothing in the way of livestock and very little in the way of seeds or fruits except the cereal grains and some vegetable seed from the old country but, on their way out, they had called at Rio de Janeiro and Cape Town partly with the object of remedying these deficiencies.

We learn from the diary of Captain Collins that at Rio they took on board the following plants and seeds: "coffee, both seed and plant; cocoa in the nut; cotton seed; banana plant; oranges, various sorts, both seed and plant; lemon, seed and plant; guava seed; tamarind; prickly pear, plant with the cochineal on it; and ipecacuanha, three sorts." This was not a particularly good selection, as, except for oranges and lemons, they either had limited uses or required a more tropical climate than that of Sydney.

At Cape Town they took on board a rather better selection: "the fig tree; bamboo; Spanish reed; vines of various sorts; quince; apple; pear; strawberry; oak and myrtle."

It is quite pleasant to read that soon after their arrival "some ground having been prepared near His Excellency's House on

the east side of the Cove, the plants from Rio and the Cape were safely brought on shore and the new settlers soon had the satisfaction of seeing the grape, the fig, the orange, the pear and the apple—those delicious fruits of the *old* taking root and establishing themselves in their *new* world". From early sketches the site of this original orchard would be in what are now lower Phillip Street and Macquarie Street.

For a community which was supposed to support itself from the products of the soil, however, the authorities concerned were definitely lacking in forethought in several respects. They had on board a variety of agricultural implements, but these were of a decidedly primitive character even for these early days and were for hand use only—spades, hoes, forks and mattocks for cultivation and scythes, sickles and flails for harvesting and threshing. There was not a single plough, harrow or cultivator to be drawn by horses or oxen.

An even more serious omission was that in the personnel of the expedition, which included a great variety of officials, there was not a skilled agriculturist to direct farming operations; for we again learn from the diary of Captain Collins that, "When Captain Phillip tried to cultivate the land he found there was no one who understood anything of gardening or farming except his own servant and much of the precious seed was lost in efforts to learn by experience. The agricultural implements supplied were very inadequate and it soon became clear that, if any good results were to be obtained, it could only be by the arrival of some free settlers skilled in agricultural pursuits."

A little later Governor Phillip himself wrote in a despatch to the home government, "If fifty farmers were sent out with their families they would do more in one year in rendering this Colony independent of the Mother Country as to provisions than a thousand convicts." Phillip's "own servant" was Henry Edward Dodd, who directed the operations of the convicts in the clearing and cultivation of the land till 1791, when he unfortunately died.

At Cape Town they also procured what was to be the nucleus of the future livestock of the Colony, the list, according to Collins, being: "one bull, one bull calf, seven cows (two of which seem to have died on the voyage), one stallion, three mares and three colts together with as great a number of rams, ewes, goats, boars and breeding sows as room could be provided for."

The cattle were undoubtedly the Afrikander breed, which is more useful for draft purposes than for the production of either

beef or milk, while the sheep were also the Cape type, which produced something more like hair than wool.

The motley crew was duly landed after some time and "removed to a spot at the head of the adjoining Cove which was cleared for a small farm".

The first farm in Australia was, therefore, located where the botanic gardens now stand, fronting Farm Cove. Except for its proximity to the landing-place, no one with any knowledge of agriculture would have chosen such a site, as the bulk of the soil is shallow and sandy with outcrops of rock at too frequent intervals.

In such an unsuitable situation and under such unpromising circumstances the pastoral and agricultural industries of Australia had their origin.

A livestock census taken on 1st May 1788 showed the following numbers: one stallion, three mares, three colts, two bulls, five cows, 29 sheep, nineteen goats, 74 pigs, five rabbits, eighteen turkeys, 29 geese, 35 ducks, 142 fowls and 87 chickens.

Even these small numbers did not have much chance of multiplying rapidly, for we read that "stock was often killed and provisions constantly stolen, particularly about the latter end of the week; as many of those unthrifty people, taking no care to husband their provisions through the seven days that they were intended to last them, had consumed the whole by the end of the third or fourth day".

Nor was that all; for in the month of June two bulls and four cows wandered away into the woods and although several parties were sent in search of them, they could nowhere be discovered. This reduced the cattle of the young Colony to the dangerous minimum of one cow, which appears to have become so wild that it had to be shot. Most of the sheep, too, were lost, partly, according to an official document, owing to the grass being unsuitable, but probably a larger number than the authorities knew of were used to supplement the rations of the convicts.

The land round Sydney Cove, as already indicated, did not look very promising and the governor himself set out on several expeditions to discover more fertile soil. He finally decided that some land should be cleared farther up the river in the vicinity of Parramatta and the bulk of the agricultural pioneering took place in this area from the beginning of November in the first year. The clearing of the land by unskilled and not very willing labour, however, took up much time, the convicts failing to

realize that their very existence depended on the success of their exertions.

With all these drawbacks and an unfamiliar climatic environment, it is not altogether surprising to learn that the first harvest was described as a complete failure, although some seed must have been recovered. The second harvest yielded only 200 bushels of wheat, sixty bushels of barley and a few bushels of oats and maize—all of which it was essential to reserve for the following year's seeding.

The original expedition had brought food supplies for only two years and this period passed without any relief or even news of any kind from the outside world. The small quantities of fruit and vegetables grown in private gardens, the surplus male domestic animals, together with some fish caught in the harbour, had been the only means of supplementing the stock. The *Sirius* was accordingly sent to China for provisions, but unfortunately she was wrecked on a reef at Norfolk Island.

Matters now looked extremely serious for the young Colony. It was found necessary to issue rations daily instead of weekly at the rate of 2½ lb. of flour, two lb. of rice and two lb. of pork per week.

A month or two passed in this way and on looking back we are forced to contemplate what now seems the incredible spectacle of this great Commonwealth, with the assistance of a considerable reserve of food stuffs, failing to support a little over 1000 people. It is doubtful whether any recorded incident in the history of the world demonstrates more clearly the vital importance of the successful prosecution of the land industries.

A flag-staff was erected at South Head so that the appearance of any approaching vessel might be made known at once to the starving people. At last a sail appeared on the horizon and on the evening of 3rd June 1790 the joyful cry, "The flag's up", resounded in every direction. The excitement was as great as if a beleaguered city had been relieved. The most graphic account of the incident is perhaps that given by Captain Tench.

> I was sitting in my hut musing on our fate when a confused clamour in the street drew my attention. I opened my door and saw several women with children in their arms, running to and fro with distracted looks congratulating each other and kissing their infants with the most passionate and extravagant marks of fondness. I needed no more but instantly started out and ran to a hill where, with the assistance

> of my pocket glass, my hopes were realized. My next door neighbour, a brother-officer, was with me, but we could not speak; we wrung each other by the hand with eyes and hearts overflowing.

They were not yet out of the wood however, and the consternation was great when it was found that the ship which had been sighted was the *Lady Juliana*, with 222 female convicts for whom Captain Phillip had asked in order to render the proportion of the sexes in the Colony more equal.

Although she brought a certain amount of surplus provisions she had to report a further tragedy for the infant Colony, namely the loss, off the Cape of Good Hope, of the store-ship *Guardian*, which had originally accompanied her, with a large quantity of provisions, plants, seeds and livestock on board.

CHAPTER II

The First Settlers

THE surplus stores carried by the *Lady Juliana* only allowed of a slight addition to the meagre ration, but the arrival of two store-ships a few weeks later effectively relieved the food situation for a period. It became more and more obvious, however, that permanent relief from threatened starvation could only come from the successful cultivation of the land and the growth of wheat and other food crops. Practically all the agricultural operations were in the hands of the government and located in the neighbourhood of Parramatta. A necessary preliminary was the clearing of the land of its timber and this, as already indicated, proceeded very slowly with unskilled and unwilling convict labour. By 1791 only 866 acres had been cleared or partially cleared for grazing and the whole area under crop on government account consisted of "300 acres in maize, 44 in wheat, six in barley, one in oats, two in potatoes, four in vines and 86 in garden ground" —not an excessive amount to show for four years' work. In addition, 55 acres, chiefly of vegetables and fruit, were being grown by civil and military officers and nine acres of cereals and vegetables by settlers. Clearly the main hope of the young Colony lay with the enterprise of the settlers. But where were they to be found?

At the outset Phillip had been instructed by the home government to give every facility for settling on the land to those convicts whose term of punishment was completed, but they were very slow in taking advantage of this privilege partly because of the lack of success in the government's own agricultural operations. A notable exception was James Ruse, who has been rightly described as "the first settler in this country". He was a native of Cornwall, where he had been engaged in agricultural pursuits. His term of punishment ended in August 1789, about eighteen months after his arrival with the first fleet. He then claimed his freedom and at first wanted to return to the land of his birth. Fortunately for Australia, he decided to remain and "was permitted by the governor to take up in the following

December a piece of ground with an assurance that, if he would cultivate it, it would not be taken from him".

In an official dispatch Captain Phillip thus describes the experiment from this point of view:

> In order to know in what time a man might be able to cultivate a sufficient quantity of ground to support himself I, last November (1789), ordered a hut to be built in a good situation, an acre of land to be cleared and once turned up. It was put in possession of a very industrious convict (Ruse) who was told that if he behaved well he should have thirty acres. He has been industrious, has received some little assistance from time to time and now tells me that if one more acre is cleared for him he shall be able to support himself after next January, which I much doubt, but think he will do tolerably well after he has been supported for eighteen months. Others may prove more intelligent, though they cannot be more industrious.

In September 1790 Ruse was married to Elizabeth Perry, who had come out as a convict with the second fleet and on 28th February 1791, after only fifteen months on the property, he renounced all claims for food from the public stores. In February 1790 Phillip had granted him his full thirty acres of land, although it does not appear to have been officially gazetted until two years later. This was the first land grant issued in Australia and the original name, "Experiment Farm", stuck to it almost up to the present day.

The records of the doings of this interesting man are somewhat fragmentary, but fortunately Captain Tench visited him on his Parramatta farm when he was getting into good going order and had an interview with him which is preserved. Amongst his statements, according to Tench, are the following:

> I have now an acre and a half of bearded wheat, half an acre in maize and a small kitchen garden. On my wheat land I sowed three bushels of wheat, the produce of this country, broadcast. I expect to reap twelve or thirteen bushels. I know nothing of the cultivation of maize and cannot therefore guess too well of what I am likely to gather. I sowed part of my wheat in May and part in June. That sown in May has thriven best. My maize I planted in August and the beginning of September. My land I prepared thus: Having burnt the fallen timber off the ground, I dug in the ashes and hoed it up, never

> doing more than eight, or perhaps nine, rods in a day, by which means it was not like the Government Farm just scratched over, but carefully done. Then I clod-moulded it and dug in the grass and weeds; this I think about equal to ploughing. I then let it lie as long as I could exposed to air and sun and, just before I sowed my seed, I turned it all over afresh. My straw I mean to bury in pits and throw in everything I think will rot and turn to manure. I have no person to help me at present but my wife whom I married in this country; she is industrious. The Governor for some time gave me the help of a convict man, but he is taken away. My opinion of the soil on my farm is that it is middling—neither good nor bad. I will be bound to make it do with the aid of manure, but without cattle it will fail.

In October 1793 Ruse sold Experiment Farm to Surgeon Harris, in whose family it long remained, and it now bears a crop of suburban cottages. His thoughts appear to have turned again to the home-land, but he found it impossible to secure a passage for himself and his family. Just about this time some much more fertile land had been discovered on the banks of the Hawkesbury in the neighbourhood of Richmond and Windsor, and Ruse obtained a block of land there, where he was again one of the pioneers. He evidently did quite well for a time, but unfortunately was one of the victims of a series of floods which ruined a great many of the 400 settlers who had been attracted to the richest district within easy reach of Sydney.

For years he battled on, a few good harvests alternating with disastrous floods. In 1809 he seems to have surrendered his land at the Hawkesbury for 100 acres in the Bankstown district, where he escaped the floods, but had his progress marred by a series of droughty years.

During his stay at the Hawkesbury and at Bankstown he spent part of his time each year as a seaman in order to have some kind of assured income.

When getting on in years he finally obtained a grant of land at Macquarie Fields between Liverpool and Campbelltown, where he lived peacefully and unobtrusively till his death in 1837.

He lived in an era when it was a common practice to compose one's own epitaph, and few tombstones in a new country are so interesting and pathetic as that of Ruse in Campbelltown churchyard.

Ruse's important role in the early development of Australian agriculture does not seem to have been fully appreciated by his contemporaries, although it is on record that among early pioneers a common harvest toast was, "Here's to Jim Ruse."

His chief virtues seem to have been his industry and perseverance, qualities which will always bring a man success and which, in exceptional circumstances, like those of Ruse, may immortalize him. The great benefit which he conferred on the young community in which he was placed was his proving that it was possible for a man with the most primitive of implements and a minimum of assistance to support himself from the land—to farm successfully.

Phillip in 1792 had received further instructions from the home government to give free grants of land to military, naval and civilian officers who had accompanied him. These men, largely because of the unfamiliar environment, were all holding back until they had seen someone make a success of farming. Ruse at Experiment Farm made a success of it, and this encouraged many officers as well as ex-convicts to follow his example, with the result that agricultural progress was greatly enhanced and the danger of famine diminished.

Of all the officers who took up land about this time by far the most capable, energetic and successful was Captain John Macarthur. He arrived in Sydney in 1790 as a lieutenant in the New South Wales Corps, accompanied by his wife, whose interesting letters home throw a great deal of light on the domestic life of the time and the general state of affairs in the young Colony.

Although somewhat impetuous, he was a man of unusual strength of character and foresight, who so excelled his brother officers in initiative and drive that he would probably have made a name for himself in any walk of life. Although he made some enemies, largely because he possessed these qualities, it was indeed fortunate for Australia that he came here. In the beginning of 1793 he was put in charge of the settlement at Parramatta, where his duties included agricultural as well as military matters.

As already indicated, he was one of the first officers to apply for and take up a grant of land on his own account. As an illustration of Macarthur's shrewdness, his original block of 100 acres was selected alongside Experiment Farm and it stretched down to the Parramatta River. He called it Elizabeth Farm after

his wife, and the stone cottage which he built on it in 1793 is generally thought to be the oldest house in Australia today. "It is some of the best ground that has been discovered," wrote Mrs Macarthur, "and ten men are allowed us for the purpose of clearing and cultivating it."

Macarthur seems to have got a move on right from the start for, writing to his brother in Britain in the following year, he says:

> I have a farm containing 250 acres of which upwards of 100 are under cultivation and the greater part of the remainder is cleared of the timber which grows upon it. Of the year's produce I have sold £400 worth and I have now remaining in my granaries upwards of 1,800 bushels of corn. I have at this moment twenty acres of very fine wheat growing and eighty acres prepared for Indian Corn (maize) and potatoes with which it will be planted in less than a month. My stock include a horse, two mares, two cows, 130 goats and upwards of 100 pigs; poultry of all kinds I have in the greatest abundance.* I have received no stock from the government but one cow; the rest I have either purchased or bred. The house is surrounded by a vineyard and garden of about three acres, the former full of vines and fruit trees and the latter abounding in the most excellent vegetables. This farm being near the barracks, I can without difficulty attend to the duties of my profession.

This striking rate of progress in two years evidently continued, for on 1st September of the following year (1795) Mrs Macarthur wrote:

> Our farm, which consists of 400 to 500 acres, is bounded on three sides by water. This is particularly convenient. We have at this time about 120 acres in wheat, all in a promising state. Our gardens with fruit and vegetables are extensive and produce abundantly. It is now spring and the eye is delighted with a most beautiful, variegated landscape; almonds, apricots, pear and apple trees are in full bloom. The native shrubs are also in flower and the whole country gives a grateful perfume. Our stock of cattle is large, we have now 50 head, a dozen horses and 1000 sheep.† You may conclude from this that we kill mutton, but hitherto we have not been so extravagant. Next year, Mr. Macarthur tells me, we may begin. I have

* He does not mention sheep although he must have had quite a number.
† Cape and Indian sheep as merinos had not yet arrived.

now a good dairy and in general make a sufficiency of butter to supply the family, but it is at present so great an object to rear the calves that we are careful not to rob them of too much milk. We use our horses both for pleasure and profit. They alternately run in the chaise or cart. Mr. Macarthur has also set a plough at work, the first that has been used in this country and it is drawn sometimes by oxen and at others by horses.

Other items of interest in the letter are as follow:

Beef might be sold at four shillings if not five shillings per lb. A good horse is worth £140 to £150, but if ever so bad it never sells for less than £100. A cow is valued at £80; an English cow, which was the property of Col. Grosse sold for £100. From this statement you will perceive that those persons who took early precautions to raise live-stock have at present a singular advantage. We have fattened and killed a great number of pigs in the year which enables us to feed a large establishment of servants. The labourers are such as have been convicts whose term of transportation has expired. They then cease to be fed at the expense of the Government and employ themselves as they please. Some endeavour to secure a passage home to England; some become settlers and others hire themselves out for labour. They demand an enormous price—seldom less than four shillings or five shillings a day. For such as have many in their employment it becomes necessary to keep in hand large supplies of such articles as are most needed by these people, for shops there are none.

From all this and from other sources it is obvious that Macarthur far surpassed all the earliest settlers in enterprise and efficiency and thus early laid the foundations of his fortune.

Writing to Governor Hunter in 1796, when he had only been four years on his expanding holding, he said:

I feel that in gratitude to the Government for their liberality I cannot do less than to declare myself both ready and willing to feed with bread, at my own expense, the servants that are allotted me; and, should your Excellency consider it advantageous to the Government to dispose of any number of men (not exceeding 100) on the same conditions, I will very cheerfully receive them. All I shall require from the public stores will be tools, clothes, nails, ironwork for building and the usual ration of salt meat. In twelve months I am of the

> opinion I can either supply myself with all these articles or, if I draw them from the Government, be able to give grain in lieu—valuing what I receive and what I return at the English market price. I will not however, pledge myself to do all this without expense to the Government within one year, but if eighteen months be not considered too long a time to allow I will unhesitatingly undertake to do it. If my example is followed, as I know it can be, by every industrious farmer, Government will be instantly relieved from purchasing grain for the whole of the labouring part of the Colony and, after the expiration of eighteen months, the grain returned to the store in exchange for tools, clothes, etc. will be more than sufficient to answer all the demands of the settlers for bread for its present numbers.

To this the governor replied, thanking him for his offer, but stating that "he had not found any others who considered their progress in farming to be such as to enable them to make a similar offer. They probably have been less fortunate or have not had the same judgment in the management of such concerns."

Macarthur made himself rather unpopular with the other free settlers by his offer and implied criticism, but the incident throws considerable light on his character.

It is well known that he was the pioneer of the pastoral industry in Australia and especially of the merino sheep, but it is not so generally known that he was the real pioneer of the agricultural and mixed farming industry as well. Whatever faults of character he possessed, there is no doubt about the fact that his enterprise and leadership more than anything else helped to put the young settlement on a self-supporting basis.

CHAPTER III

Macarthur and the Wool Industry

WITH the arrival of a few free settlers, the taking up of more and more land by officers, civilians and ex-convicts and the expansion of the agricultural industry westward of Parramatta and especially on the fertile banks of the Hawkesbury, the food requirements of the young Colony were gradually supplied in adequate amounts in normal seasons. Occasional drought periods and disastrous floods still caused temporary shortages, which were lessened in severity by importations of grain from Tasmania, where two settlements were founded in 1803 and 1804.

The greatest problem now became the production from the land of some article of high value for its weight which might be exported to Britain to pay for the increasing requirements in the way of clothing materials, agricultural implements, domestic appliances and other necessities. The answer came in the introduction of the merino sheep and the development of the fine-wool industry.

Australians are so accustomed to the merino that they are apt to regard its conformation and qualities as the normal thing in the sheep world and to look on British breeds as unusual, if not freakish. In reality it is the merino which varies most from the average, as it is unique in certain important respects. Whereas all other breeds of sheep have been developed for their mutton or for dual purposes (mutton and wool) the merino has been developed almost entirely for the quantity and quality of its wool, the carcass being of quite secondary importance.

The wool differs greatly from that of any other breed and has a considerably higher value. It is not so lengthy as in the British long-wools, but it is much denser and there are many more wool fibres to the square inch (45,000 on the average). Allied to this is its fineness, the diameter of the individual fibres being less than half of that in most other breeds. Then it has greater crimpiness (a much larger number of corrugations per inch) and a greater number of serrations on the individual fibres, so that its spinning value, especially for fine woollen materials, is the

highest of any type of wool produced in large quantities anywhere. Besides this superiority in quality, it shows the greatest proportion of wool to carcass of any breed. The sheep itself is hardy and yet docile. It will stand heat and cold, hunger and thirst better than any other breed; does well on dry feed and will travel far for its food and water supply. The only conditions which do not suit it are heavy rainfall, saturated soil and high atmospheric humidity. It is therefore chiefly confined to the drier parts of the temperate and sub-tropical regions of the world. It would be difficult to imagine any class of livestock better suited to Australian climatic and economic conditions. That being so, it would appear to have been the easiest and most natural thing in the world to introduce the merino to the new Colony in the southern seas. But herein lay the difficulty; at the time of the foundation of Australia and for some time thereafter, Spain had practically a monopoly of the breed, and British manufacturers had to pay rather extortionate prices for merino wool in consequence. The sale of merino sheep from Spain was absolutely prohibited, and practically the only way in which they could reach the outside world was when a Spanish monarch wished to curry favour with a foreign government. He might then present a few to them as a very special favour.

The arrival of the first merinos in Australia was due to a fortunate combination of circumstances which many people would regard as providential. In the year 1796 (eight years after Australia's foundation) two ships were sent from Sydney to Cape Town for supplies in charge of Captain Waterhouse and Captain Kent. While they were anchored in Table Bay the only merino sheep in the southern hemisphere were put up for sale. It seems that the king of Spain had presented a few merinos to the Dutch government. The climate of Holland was entirely unsuitable and some of them were sent to South Africa in charge of Colonel Gordon. Whether Gordon received them as a gift from the Dutch government or not is rather obscure, but the evidence rather favours this idea. A short time before the Australian ships arrived at Cape Town, Colonel Gordon died and his widow decided to sell off and return to Europe. On board one of the ships was the commissary for New South Wales, who had instructions to buy cattle but not sheep and consequently did not attempt to purchase them for his government.

Before the ships left for the Cape, Captain John Macarthur had evidently requested Waterhouse and Kent to bring back any fine-wooled sheep they could pick up and promised them a

reasonable profit. It was probably this prompting that induced these two naval captains to purchase the lot between them and to bring them back to Sydney. The price was £14 each plus £1 per head for transport to the ships. Twenty-six were embarked but some died on the voyage and some of the ewes produced lambs on board. There is considerable conflict about the exact numbers which actually landed, but there could not have been more than thirty, including lambs. Shortly after their arrival Captain Macarthur offered £15 per head for the total consignment, but Captain Waterhouse kept a few for his own property and sold the remainder to a few individual land-holders besides Macarthur, so that they might be distributed as widely as possible. Macarthur actually obtained three rams and five ewes. The proportion of rams to ewes in the total consignment was too great and so most of the former were used for mating with ewes already in the country, which were mainly of hair-bearing Cape and Indian breeds, although there were a few of British origin, like the Southdown, as well. There is abundant evidence that Macarthur was the only one to keep a proportion of his merinos separate from the others and thus to build up a small flock of pure merinos at Elizabeth Farm. It is difficult to exaggerate the importance of his action for the future of the Australian pastoral industry.

In 1800 Macarthur sent eight fleeces to Sir Joseph Banks for expert opinion. Very favourable reports indeed were received of that of a pure merino ewe imported from South Africa and of a ram bred from it, the valuations being four shillings and five shillings per pound respectively.

This was in striking contrast to the report on the fleece of a Bengal ewe, "the hair only fit for the bricklayer to mix amongst mortar to build their houses".

This encouraged Macarthur to persevere with his pure flock, although he had of necessity to use some of his merino rams partly for cross-breeding purposes. His intolerance of inefficiency, his sensitiveness to criticism and a rather quarrelsome disposition—not infrequent accompaniments of a dynamic personality—frequently led Macarthur into trouble.

He had disputes with every governor, Hunter using such phrases as these about him in his dispatches, "the horrid depravity and wickedness of this man't heart" and "the unpardonable design of this artful, mischievous and troublesome character". When King succeeded Hunter in 1800 Macarthur's relations with him were no more pleasant and he offered to sell out his

RUSE'S HEADSTONE

JOHN MACARTHUR

property and livestock to the government for £4000 with a view to his returning to Britain. King recommended to the home government that this offer be accepted, but fortunately for Australia the Duke of Portland refused, at the same time expressing his astonishment at "an officer of the army being a farmer to the extent he appears to be".

In 1802 Macarthur is recorded as possessing 3950 acres and owning 2750 sheep and being "by far the principal land-holder and pastoralist in the Colony". In 1801, however, Macarthur had a violent quarrel with his superior officer, Colonel Paterson, who challenged Macarthur to a duel on 14th September. Patersson was wounded in the shoulder and King put Macarthur and the seconds under arrest and Macarthur was sent to England for trial by court-martial.

In his dispatch to the home government King wrote, "I have been obliged to send him home under arrest with such proof of his having attempted to create dissentions between me and Col. Paterson; If ever Capt. Macarthur returns to this Colony I shall feel much for its concerns. Half of it belongs to him already and he very soon will get the other half. Should it so happen that he is allowed to return here in any official capacity it should be that of Governor. . . . I have mentioned the above to prevent the Government being imposed on by this rich Botany Bay perturbator." It is worthy of note that in after life Macarthur was on quite friendly terms with both Hunter and King.

Macarthur does not appear to have received any punishment for his part in the duel with his superior officer, but was not allowed to return to New South Wales for about four years. In the meantime he made excellent use of his time.

In 1803 he sent to the colonial office a "Statement of the Improvement and Progress of the Breed of Fine-wooled Sheep in New South Wales", in which he claimed that experts declared fleeces submitted by him to be "certainly equal in every valuable property to the very best to be obtained from Spain". He pointed out that the value of fine wool imported into England from Spain and other countries annually was £1,800,000 and estimated that in twenty years wool of that value could be raised in Australia alone. Sir Joseph Banks, who was adviser to the colonial office on all such matters, did not at first support Macarthur's claims, as he considered the pastures unsuitable, but later withdrew his opposition after Macarthur had mustered evidence from Captain Waterhouse and Hunter. Macarthur also obtained strong support from some of the leading woollen manufacturers

of England. In May 1804 he addressed a further memorial to the Privy Council re the suitability of New South Wales for the fine-wool industry and made two alternative propositions, namely:

1. To form a company on a large scale for the production of merino wool of which he would act as manager.
2. To undertake the extension of the industry on a large scale himself if given a grant of 10,000 acres of land and the use of thirty convict shepherds.

Shortly thereafter another event of the greatest importance to Australia took place. Except for a few which had been dispersed from it, almost the only merino sheep in Britain were in King George's flock at Kew—the progeny of a few received as a present from the Spanish government. As the breed was not suitable to English conditions, the king and his advisers did not desire to increase the flock to any extent and in 1804 a dispersal sale of surplus stock was held. John Macarthur was, of course, a keen competitor at the auction and he succeeded in purchasing eight of the limited number offered.

Sir Joseph Banks, who was not always friendly to Macarthur, drew attention to an ancient English law, which had never been repealed, forbidding the export of sheep under penalty of the offender being "branded on the forehead and having his right hand cut off".

This obstacle was overcome, however, and Macarthur chartered a ship, re-named it the *Argo*, placed a golden fleece as a figure-head and returned in triumph to Sydney on 7th June 1805 with

1. Six pure merino sheep—five rams and one ewe—two having died on the voyage.
2. The promise of a grant of 5000 acres of land in a district of his own choice and of the services of no fewer than thirty convicts as shepherds.
3. A selection of plants for the new Colony, including olives and vines.
4. Two expert wool-sorters as settlers.

Incidentally he also had on board his daughter Elizabeth and her governess, and his nephew Hannibal, while he left behind his two sons Edward and John to complete their education in England.

From the small consignment from South Africa, and the six obtained by Macarthur from King George's flock at Kew, a few imported from England by Rev. Samuel Marsden, and one ram

presented by the Duke of Northumberland to Major Johnston, the great merino flocks of Australia have been built up, although there were quite a number of importations from time to time in later years.

On Macarthur's return in 1805 he resigned his army position in order to devote himself entirely to agricultural and pastoral pursuits. He became reconciled to Governor King, although they had a difference over the location of the 5000 acres allotted to Macarthur. The choice of this land is rather interesting.

In 1795 a number of natives appeared at the settlement in Sydney, making gestures and sounds which indicated that they had seen the progeny of the bull and four cows which had disappeared into the bush in the early days. An expedition was sent out with the aborigines as guides and the cattle were discovered in the neighbourhood of what is now the town of Camden. The land on whch they were pasturing was named the "Cowpastures". John Macarthur reasoned that these cattle had the choice of all the land in proximity to Sydney and, as they had settled down on the banks of the Nepean and the slopes in the neighbourhood, he would be wise to accept their verdict and choose this land. Governor King had decided that the cattle should be allowed to range and multiply where they had been found and therefore favoured retaining the area as a reserve for them. Macarthur, however, had his way again and received a grant of 5000 acres, afterwards increased to 10,000 acres, in that area, and Camden Park has been the headquarters of a section of the Macarthur family and their descendants ever since.

All went smoothly for a time and by 1807 Macarthur had 5400 sheep, only a portion of which was pure merino, or more than one-fifth of the sheep in the Colony, although there were by that time over 750 land-holders in New South Wales.

Then a new governor arrived to take the place of King in the person of Captain Bligh, whose mind had been prejudiced against Macarthur before he reached Sydney. As he had the same kind of domineering explosive personality, a conflict between the two was almost a foregone conclusion, and Macarthur was undoubtedly concerned in the drastic step of the arrest of the governor by Major Johnston, the commander of the New South Wales Corps.

Johnston assumed the office of provisional governor, with Macarthur as unpaid secretary to the Colony. But such a revolution could not be condoned, and Johnston himself demanded an inquiry.

Johnston and Macarthur were ordered home for court-martial. The former was cashiered, but Macarthur, now a civilian, could not be tried in England, but was prevented from returning to Australia for 8½ years. Again his time was not altogether wasted, as he made a careful study of the market requirements for wool, examined every shipment of wool from Australia and pointed out faults in the grading, packing and general get-up. He also visited France and Switzerland and made a careful study of the viticultural and wine-making industries.

In the meantime his wife carried on the agricultural and pastoral operations with remarkable success and too great a tribute can hardly be paid to her efforts during his two prolonged absences. But for them Australia would not have had such a secure foundation on which to build her fine-wool industry.

Macarthur, of course, did all he could to help her from a long distance, which meant so much more in time than it does of recent years. In his frequent letters to her we find such instructions and admonitions as these:

> Let the most watchful attention be paid to improve the flocks upon the plan I recommended to you. . . . Be careful of the Spanish sheep and let no pains be spared in culling the flock. . . . All your arrangements have my perfect approbation, but how does it happen that you have never once sent me a return of the stock? . . . You will rejoice to learn that the value of the wool is established beyond doubt and that we may calculate as upon a certain thing that wool of the quality of our most improved kind will sell for a guinea a fleece taking one with the other. . . . The wool by the *Admiral Gambier* arrived in excellent condition and will be sold soon. It is valued at five shillings per pound averaging one quality with another. It *measured* near two tons by which means the freight came to the enormous sum of £38. When wool is sent in future it should be washed as clean as possible and the agreement for freight should be by the pound. . . . All you have done and all you propose to do in the management of our concerns appear to me most prudent and beneficial but, if your markets continue to fall in price it is obvious enough that the only marketable commodity will be wool. It is therefore of the utmost importance that the finest-wooled ewes should be selected to breed from.

That wool production was by no means the only activity on the Macarthur properties at this time, is shown by a letter

written by Mrs Macarthur in 1816. After describing the great variety of fruit in the orchard she continues, "We grow wheat, barley, and oats; we make hay (at least I do and so does Mrs Macquarie); we feed hogs, we have cattle, keep a dairy and fatten beef and mutton and export fine wool."

In 1817 Macarthur returned to Australia from his second exile with his name cleared and with free passages for himself and two of his sons. He still made Elizabeth Farm his headquarters while his two sons—James and William—developed the property at the Cowpastures under his direction.

The following year he complained "that although mine is the only flock from which Spanish rams can be had pure, I do not sell half a score a year". This position must have been remedied a short time thereafter, as in 1820 he sent 300 young rams to Tasmania.

In 1821 John Thomas Bigge in his historical report on the affairs of the Colony referred to the fine-wool industry as "this hitherto neglected mine of future wealth and prosperity" and commended Macarthur for his almost single-handed efforts. In giving evidence before Bigge in that year Macarthur stated that he had 6800 sheep, that the average weight of fleece was 2 lb. 7 oz. and that the maximum carrying capacity on natural pastures was a sheep to the acre. For his merino flock, however, Macarthur did not depend solely on natural pastures as he experimented with introduced grasses and clovers and in winter they got turnips, rape and forward wheat.

Macarthur was now beginning to reap real financial rewards for his persistent labours as well as to gain recognition from outside. In 1822 the society of arts presented him with two gold medals—one for importing 13,000 lb. of fine wool from New South Wales and one for importing fine wool equal to the best Saxon from New South Wales.

Two years later he was awarded a larger medal by the same society for importing the largest quantity of fine wool.

Macarthur and his sons continued to take great pains to study market requirements, James going home with the wool in 1828 and remaining for two seasons while Macarthur himself superintended the sorting and classing of the wool in Australia.

He was appointed a member of the first legislative council of New South Wales in 1825 and held office till 1833. In the following year he passed away at Camden Park while the ambitious homestead which he had planned was in course of erection.

By that time his dreams of an industry which would bring

great wealth and prestige to his adopted country were beginning to be realized. More and more graziers possessed pure merino flocks and the exports were reaching quite substantial proportions. In 1807 the total quantity of wool shipped from Australia was only 245 lb., whilst in 1835 it was 3,776,000 lb. and the fine-wool industry was now firmly established. Whatever may be said against his personal character—his haughty manner, his quarrelsome disposition, his doubtful trading practices at a time when the ethical standards in such matters were not very high, and the part which he took in the arrest of the king's representative, they are largely balanced by his loyalty to his friends and his very evident affection for all the members of his family.

He undoubtedly ranks amongst the foremost benefactors of Australia as the real founder of the industry on which the prosperity of the Commonwealth still so largely depends and it seems rather anomalous that no worthy permanent memorial has been erected to commemorate his achievements.

CHAPTER IV

Exploration and Pastoral Expansion

By 1810, when Macquarie took over the administration, New South Wales was still a small penal settlement with a population of between 11,000 and 12,000 people spread over an area within a radius of about forty miles from Sydney including a large proportion of very inferior soil. Under cultivation were 7615 acres of land to the west, north-west and south-west of Parramatta, which was all gradually becoming impoverished by continuous cropping except on the rich alluvial flats of the Hawkesbury and Nepean. The latter provided the bulk of the food supply, while, as we have seen, the nucleus of a pastoral industry had started through the initiative of Captain Macarthur. Macquarie had a clearer vision of future posibilities than any of his predecessors and gave every encouragement to the exploration of the country beyond the settled areas. The Blue Mountains stood out as a forbidding barrier to westward expansion although some former governors regarded it as a useful prison wall. Three previous expeditions had attempted to surmount it, but the leaders all came back with much the same report that "this formidable barrier is impassable by man". On 11th May 1813 a party led by Gregory Blaxland, one of the earliest free settlers, Lieutenant Lawson and the youthful William Charles Wentworth set out on an expedition which adopted the sensible principle of keeping to the highest land as they went westwards and succeeded in effecting a crossing. A second party under the leadership of Surveyor Evans followed their route and penetrated the country many miles beyond the range, bringing back the report that "it contains a number of extensive and very fertile plains very thickly wooded and well watered with a number of streams". The governor then ordered a cart road to be constructed across the mountains and placed the task in the hands of William Cox, then chief magistrate of Windsor, allowing him the labour of 36 convicts. It could only have been a rough track, for it was completed in the surprisingly short time of six months. This prepared the way for the memorable journey

by the governor and Mrs Macquarie and a large party, who arrived on the banks of the Macquarie River early in May 1815 and fixed on Bathurst as the site for a future town. They left behind a number of men to cultivate a few acres of wheat and vegetables in order to test the productive capacity of the soil. Permission was also given to several stock-owners to send some cattle across the mountains to graze in the newly discovered country. Some cattle from the government herds were also sent as an experiment. The governor himself reported the results in one of his dispatches:

> Both these experiments have exceeded our most sanguine expectations, those small pieces of cultivated land and garden-ground producing most abundant and excellent crops of wheat and vegetables without the ground being manured except in a trifling degree. Both the Government cattle and those belonging to individuals have greatly benefited already by the change and the whole wonderfully improved in size and appearance owing to the abundance of rich grass and water to be met with in all parts of the country.

It was not long before much of the fertile country around Bathurst became occupied chiefly by graziers, as the distance to the only large market at Sydney made the cost of transport of grain across the mountains prohibitive. Further explorations by Oxley and others brought news of the existence of more rivers and promising grazing land in every direction.

It is almost impossible to exaggerate the importance of these discoveries as they changed the whole complexion of the Colony, which had previously been hemmed in on all sides by the sea and a chain of mountains. The good news spread to the home-land and many new settlers were attracted. Indeed, from this time the real progress of Australia may be said to have taken its start. A wave of pastoral expansion gradually swelled over the mountain range guided in its course by the hardy pioneers until by degrees it gained in force and burst over the forest-clad slopes and fertile plains of the interior, followed in due course by its close companion agriculture.

Macquarie left the Colony in 1822 after twelve years of a memorable term of office. Although not free from conceit, as indicated by the number of physical features which still bear his name, there was some justification for his enthusiastic report to the home government on its conclusion, which read in part as follows:

> I found the Colony barely emerging from infantile imbecility and suffering from various privations and disabilities; the country impenetrable beyond 40 miles from Sydney; agriculture in a yet languishing state; commerce in the early dawn; revenue unknown; threatened by famine; distracted by faction; the public buildings in a state of delapidation and mouldering to decay; the few roads and bridges formerly constructed rendered almost impassable; the population in general depressed by poverty; no public credit nor private confidence. . . . I left it in February last reaping incalculable advantages from my extensive and important discoveries in all directions including the supposed unsurmountable barrier called the Blue Mountains, to the westward of which are situated the fertile plains of Bathurst; and in all respects enjoying a state of private comfort and public prosperity which, I trust, will at least equal the expectations of His Majesty's Government.

The progress of the Colony under his administration is confirmed by the following figures.

	1810	*1821*
Population	11,590	38,788
Horses	1,134	4,564
Cattle	12,452	102,939
Sheep	25,888	290,158
Pigs	9,544	33,906
Acres cultivated	7,615	32,267

So satisfactory had the food supply become that in 1819 a cargo of flour was actually exported to South Africa, although "the profits of the speculation were not such as to encourage a repetition of it".

Just as important as the material gain which resulted from the crossing of the Blue Mountains was the change in the psychological outlook of the whole community, which began to realize that New South Wales was not merely a penal Colony from which a departure should be made at the earliest opportunity, but an important part of the British Empire calling out for the development of its land and mineral resources. This gave a tremendous impetus to further exploration and settlement, not only across the mountains but to the north and south of Sydney.

Proceeding in a southerly direction no extensive area of good land near the coast is encountered until the Illawarra district opens out and this was at first used for the growth of cereals and vegetables until rust and other diseases of a humid climate drove

these industries inland. Besides the utilization of its valuable cedar timber, it gradually changed over to become the leading dairying district in Australia for many years. To the north of Sydney a great deal of the land is of inferior quality until the Hunter River valley is reached at a distance of nearly 100 miles. Two early expeditions, strange to relate, had brought back unfavourable reports of one of the most fertile regions in the whole of Australia, although they reported the discovery of coal in the neighbourhood of Newcastle. Further explorations discovered the true value of the district and there was a great wave of settlement there during the governorships of Brisbane and Darling, who followed Macquarie.

Dangar, a leading surveyor, tells us that between 1822 and 1826, 372,000 acres were taken up there by settlers:

> The traveller's attention is everywhere arrested by a busy agriculture. Houses and lands of respectable settlers, healthy and well-fed labourers and every appearance denoting rapid improvement. Here in 1827 were upwards of 25,000 head* of (horned) cattle and 80,000 fine improved wool sheep† with a capital already in possession of settlers and in great activity (independent of the original value of the land) of £400,000. This is a state of capital or industry embraced in one division of the Colony in five years of which I doubt whether a parallel instance in the annals of colonisation can be adduced.

To the south-west, rapid expansion of settlement was also proceeding in the southern highlands in the Bowral, Moss Vale, Berrima districts as far as Goulburn and Yass and even expanding on to the Monaro plains at first called the Brisbane Downs, whilst considerable progress was also taking place west of the mountains radiating from the original centre of Bathurst. Too great a tribute can hardly be paid to the numerous explorers who brought back reports which paved the way for settlement. Oxley, the surveyor-general, was one of the main contributors at this time by both land and sea. In 1818 he explored a great area of country between the Macquarie marshes and the mouth of the Hastings. In 1823 he discovered the Brisbane River from the sea and soon after a new penal settlement was established on the site of the present city of Brisbane. A year later Hume and Hovell made their famous overland journey to Port Phillip, where Melbourne now stands. Percy Simpson explored the Wel-

* More than twice the number of cattle in the whole of New South Wales in 1810.
† More than three times the number of sheep in the whole of New South Wales in 1810.

lington district and a little later Allan Cunningham discovered the road to the rich pastures of the Liverpool Plains, getting over the dividing range from the upper Hunter. He laid the Colony under a further debt of gratitude by proceeding northward through New England to the Darling Downs, one of the most fertile inland districts in Australia. Starting from Brisbane, he completed the picture by proceeding thence to the Darling Downs and also to the source of the Brisbane River. In 1828 Captain Sturt made a long tour through promising pastoral country on the Castlereagh and as far as the Darling and in 1830 made his famous journey to and along the Murrumbidgee and Murray rivers to Encounter Bay in South Australia, where the Murray makes a rather inglorious entry into the sea. Their reports opened up great opportunities for settlement by adventurous spirits, who, as we shall see, gradually spread farther and farther out from civilization with their flocks and herds.

With an immense area of land in sight, the great needs of the Colony were now labour, enterprise and capital, preferably in the form of livestock. A partial solution of all these came in the formation in England of the Australian Agricultural Company. It is easy to perceive the hand of John Macarthur behind its planning, as it was really an elaboration of a former proposal of his. The board of directors in London included his lawyer son, who had settled there; another son, his nephew Hannibal, and his son-in-law were all members of the New South Wales committee.

The company, which had a capital of £1 million, had as its main object the development on a large scale of the fine-wool industry in New South Wales not only by buying locally-bred sheep but by purchasing some of the finest merinos obtainable in France and Germany, which now possessed valuable flocks, as the Spanish monopoly had been broken down as the result of the Peninsular war of about twenty years before.

By royal charter of November 1824 the Australian Agricultural Company was given a free grant of a million acres of land in New South Wales in any selected position which would not interfere with other settlers. In June of the following year two of the company's ships set sail with a party of shepherds and other workers and aboard were also 700 merino ewes and rams, fifteen thoroughbred horses and mares and twelve stud cattle.

On the advice of Oxley, the site first selected for the settlement was Port Stephens, with the suggestion that the necessary area

of pastoral land could be found between there and the Manning River. Exploration of this district, however, revealed that much of the land was of inferior quality and that the best of it was more suitable for cattle than for merino sheep. The home government therefore gave permission for about one half of the million acres to be selected farther inland and the final allocation was:

Locality	*Acres*
Between Port Stephens and the Manning River	464,640
At Warrah on the Liverpool Plains	249,600
South of the Peel River near Tamworth	313,298
TOTAL	1,027,538

It is worthy of note that the new areas considerably exceeded the half-million acres suggested and that the total area showed a margin of 27,538 in favour of the company.

One repercussion of the company's formation is described in characteristically forceful language by Rev. Dr John Dunmore Lang:

> No sooner had the operations of the Australian Agricultural Company been duly announced and its operations commenced in right earnest than the "sheep and cattle mania"—a species of madness formerly unknown even in this Colony—instantly seized on all ranks and classes of its inhabitants. . . . Barristers and attorneys, military officers of every mark and civilians of every department, clergymen and medical men, merchants, settlers and dealers in general were seen promiscuously mingled together every Thursday and outbidding each other in the most determined manner for the purchase of every scabbed sheep or scarecrow horse or buffalo cow that was offered for sale in the Colony. In short, it was universally allowed that the calculations of the projectors of the Australian Agricultural Company could not possibly be inaccurate and that the owner of a certain number of sheep or cattle in New South Wales must, in a certain number of years, infallibly make an independent fortune. It was consequently determined that the Australian Agricultural Company should not be the only reaper of the golden harvest. . . . It pleased Divine Providence, however, to visit the Colony in the midst of these speculations with an afflictive drought of nearly three years' continuance, the effect of which, combined with the natural result of the sheep and cattle mania, was completely to open the eyes of the colonists to their own folly and madness,

to blast the golden hopes of multitudes and to bring many respectable families to poverty and ruin.

In spite of this repercussion the company gave a great fillip to the beef cattle industry by importing good quality Shorthorn or Durham cattle which were chiefly pastured on the Port Stephens and Warrah properties and by selling some of their progeny to private settlers. Its greatest service, however, was in the rapid development of the sheep and wool industry. Further consignments of pure merino sheep of the highest quality were purchased from the leading flocks of Saxony and sent out chiefly at first to the Peel River property and later to Warrah. No expense was spared provided the weight and quality of the fleeces reached a high standard and this infusion of new blood ultimately benefited the whole of the sheep in the Colony. By December 1828, three years after its foundation, the flocks of the company numbered 17,459. The Australian Agricultural Company was also responsible for putting the coal-mining industry in Australia on its feet.

With pastoral expansion taking place at a rapid rate, it became necessary to set a limit to the area within which land grants could be made and police protection provided. In 1829 this was clearly defined as the nineteen counties which included all the land "from the Manning River to Moruya and from the Lachlan to the sea". The picked spots of this area were rapidly filled up by ex-convicts, the sons of earlier settlers and new immigrants, who were given free grants of land in ever-increasing volume, the bulk of which was used for grazing. Agriculture was still largely confined to the more fertile districts like the valleys of the Hunter and the Hawkesbury and only aimed at producing sufficient food for local requirements.

CHAPTER V

New Colonies Arise

WHILST the Colony of New South Wales had thus expanded to the theoretical limits of the nineteen counties, other settlements, precursors of new States, were gradually coming into being. We have already seen that a separate penal Colony was started on the Brisbane River in 1823, but it remained an isolated community for two decades, until the march of the squatters from New England and the Darling Downs linked it up with the main settlement. From this nucleus the future important State of Queensland, which remained part of New South Wales till 1859, gradually developed.

The second Colony, in order of foundation, was Tasmania, or Van Diemen's Land, as it was at first called. Largely due to the fear that the French intended to start a Colony there, Governor King of New South Wales in 1803 sent a small expedition to found a new penal settlement in a beautiful situation on the banks of the Derwent, where Hobarrt now stands, and a year later a similar one was established at Port Dalrymple at the mouth of the Tamar and later transferred to the site of the present town of Launceston farther up the river. In 1810, not very long after his arrival in Australia, Macquarie visited the island, and the two isolated settlements were united under the charge of Colonel Davey. The early history was very similar to that in New South Wales. There were the same alternating periods of famine and comparative plenty, the same attempts by the convicts to rob the stores, and even more serious conflicts with the more difficult native population. As the white inhabitants gradually settled down, their agricultural efforts were more successful than on the mainland, as the climate of Tasmania more nearly approaches that of England. Wheat was actually exported to New South Wales in years when droughts or Hawkesbury floods reduced the harvest there. The introduction of merino sheep from Captain Macarthur's flock paved the way for the development of the pastoral industry in the interior, while agriculture was confined largely to alluvial land in the south

and north and to fertile upland soils stretching towards the north-west coast. In the development of the latter area the Van Diemen's Land Company, founded and operated on similar lines to the Australian Agricultural Company on the mainland, played a prominent part. This company, which started operations in 1828, obtained a grant of 350,000 acres and did very good developmental work, importing large numbers of good stock and improved farm implements. It usually employed good managers who brought with them from Britain up-to-date ideas which were directly applicable to Tasmanian conditions. The progress of both pastoral and agricultural industries was thus greatly speeded up.

As Tasmania has a large proportion of rugged mountainous country and almost impenetrable bush, the bulk of the really good land was soon taken up, and adventurous Tasmanians, especially those who disliked the prison atmosphere of the island, began to cross to the mainland.

Victoria

In 1834 the Henty brothers took implements and livestock from Tasmania to Portland Bay and combined agricultural and pastoral pursuits with their whaling enterprises. A year later John Batman, who had formed a company to acquire land and engage in stock-breeding at Port Phillip, arrived at Geelong. In the course of his explorations he discovered the Yarra and selected the site where Melbourne now stands as the "best place for a village". His great difficulty was to obtain any kind of title to his land and that gave rise to Batman's famous agreement with the native chiefs, by which he was to obtain 600,000 acres in return for this interesting list of commodities: forty pairs of blankets, 130 knives, 42 tomahawks, forty looking-glasses, 62 pairs of scissors, 250 handkerchiefs, eighteen red shirts, four flannel jackets, four suits of clothes and 150 lb. of flour. That was not quite the whole bargain, however, as he had still to pay an annual rent of specified quantities of most of these items. In spite of the uncertainty of tenure, several other groups of Tasmanians crossed the strait, and pastoral and agricultural pursuits spread out in fanlike formation from the neighbourhood of Melbourne, and so what was to become the State of Victoria really came into being, although there had been two former unsuccessful attempts at occupation and Hume and Hovell had visited Port Phillip ten years before.

Western Australia

In the twenties and thirties of last century there was a marked desire on the part of many people in Britain to own and develop large areas of land, and Australia, with its huge extent of territory, seemed a natural place for the land-hungry. The west coast had been entirely neglected, probably due to the barren appearance of a large proportion of its foreshores as seen by the Dutch on their way to the East Indies. Captain Stirling, however, on cruising along the coast, was greatly impressed by the beauty of the Swan River and its surroundings. From the water the native vegetation looked quite luxuriant, and he therefore recommended those who were keen to try their fortunes in this new land to form a settlement there. Within a year (1829) hundreds of adventurers arrived, exhibiting amazing faith, as nothing was really known about the soil or climatic conditions. The principle of allocating land was the novel one of so many acres for each unit of property brought out—forty acres for every £3 worth of goods. The first fleet was consequently loaded with a great variety of articles, many of which were of little or no value in developing the agricultural and pastoral resources. Those possessing most property, and thus eligible for the largest areas, had first choice, and naturally chose the land nearest the projected city, so that claimants for smaller areas had allotments marked out a great distance away on a map of country which had never even been explored. Most of the land in the allotted area appeared sandy and poorer than it really is. The long hot summer and scanty rainfall presented them with a puzzling environment; the native flora contained quite a number of poisonous plants, and the aborigines did not understand this new invasion and were not always friendly. Much of the precious livestock died and little success was met with in the attempts to grow crops. Several of the settlers died of thirst or at the hands of the natives, and the whole state of affairs was so gloomy that all who could afford it returned to England or tried their luck in one of the other Colonies. It is not surprising, therefore, that little progress was made in the first half-century of Western Australia's history. The position was redeemed to a certain extent by the discovery of good pastures in the neighbourhood of Champion Bay and by the exploitation of the valuable jarrah timber of the forests to the south of Perth. It was suggested that affairs might be livened up by the introduction of convicts, who would, at least, provide cheap labour and increase the local demand for products of the soil. At first the settlers objected, but

finally in 1848 consented on the principle that any kind of change would be better than none. The experiment was not very successful, however, and at the unanimous request of the people transportation ceased.

South Australia

Just about the time the first settlers reached Western Australia, there was published in London a pamphlet entitled *A Letter from Sydney*, by Edward Gibbon Wakefield, suggesting the founding of a new province along the south coast on somewhat different principles. His views and proposals may be briefly summarized as follow:

> New South Wales, owing to its convict element and the ease with which emancipated convicts acquire land, is no place for wealthy or cultured people who desire colonial life and experience. There are no definite lines of demarcation in society—no true aristocracy. Let's found a settlement somewhere else in Australia where the minimum price of land shall be twelve shillings per acre. Let people with capital and culture emigrate there, secure land, encourage immigration of poor people who will act as labourers and thus found a Colony whch will be more akin to England in constitution and ideas.

In spite of the news that was trickling home about conditions in Western Australia, quite a number of people were attracted by this rather snobbish scheme, and two pioneer vessels sailed in 1836. They landed first at Kangaroo Island, where there was a small whaling station, and then crossed over to the mainland. After some exploration, they finally fixed on the place where Adelaide now stands as the best place for a town. It is beautifully situated at the foot of the Mount Lofty Range, but has the drawback of being seven miles from the nearest port, and difficulties were experienced in transferring the settlers and their belongings through the trackless bush. Seven more ships followed during the year, and by March 1837 the survey of the new capital was completed. Then began the sale of allotments at prices ranging from three to thirteen pounds per acre. Instead of pushing on with the cultivation of the soil, which looked rather unpromising, they spent their time building houses, speculating in land and quarrelling amongst themselves, whilst many of the labourers were unemployed. A successful Colony could not, of course, be built up on such an economic foundation.

The first governor, Hindmarsh, was recalled and Gawler, soon after his arrival to replace him, gives this picture of the state of affairs:

> All the means of the colonists are vanishing in payment for the necessities of life. There are scarcely any settlers in the community, no tillage, very few sheep or cattle pasturing, the population shut up in Adelaide existing principally upon the unhealthy and uncertain profits of land jobbing, whilst the public finances are in a hopeless muddle.

This could not go on for long. Speculation in land was soon followed by a general desire to sell at any price, and consequently the value of real estate fell lower and lower. The supply of provisions ran short, and the little community was faced with starvation. Most of those who could afford it packed up and either went to one of the other Colonies or obtained a passage back to England. It was like building a house without foundations, for any such new community must first devote its main attention to the fundamental land industries.

After a time this lesson was learned. The exorbitant cost of provisions induced the people to grow wheat and vegetable crops and engage in the rearing of stock, the greatly reduced price of land enabling many of the poorer people to engage in farming pursuits. Graziers from New South Wales and Victoria began to arrive with sheep and cattle for sale, and some of them were so well pleased with the country in the neighbourhood of Adelaide that they determined to remain. A writer of the period gives this rather vivid picture of the state of affairs:

> The little settlement at this time presented a curious spectacle. Society might be roughly divided in three classes—(1) the original immigrants who had started from England with a certain amount of capital which had, as a rule, been squandered in speculation, (2) the wretched starving labourers, and (3) the overlanders from the other Colonies, who frequently dissipated much of what they received for their livestock in noisy revelry which scandalised the little town. These wild bushmen were the only people who were either contented or well-to-do, and their prosperity stood out in greater contrast owing to the misery and hopelessness of their surroundings.

When they began to cultivate the soil it proved more fertile than its appearance indicated. As a matter of fact, the soil and

climate near the city of Adelaide are more suitable for the growth of wheat than those in proximity to any of the other capital cities of Australia. By degrees both agricultural and pastoral pursuits were placed on a proper footing, and after a few years of steady work the province not only supplied its own food requirements, but actually exported wheat and dairy produce to the other Australian settlements. By 1841 only 2500 acres were under cultivation, but this had increased to 26,000 acres four years later, and to 65,000 acres in 1850, when the invention of the stripper had begun to make its influence felt.

As the years passed, the South Australian farmers, reinforced by some excellent immigrants from Germany, proved more resourceful and efficient than any other group on the Australian continent.

CHAPTER VI

The Era of Squatting

At the main settlement in New South Wales the most desirable locations within the surveyed nineteen counties were rapidly occupied. Up till 1831 the only method of acquiring land was by free grants, although some areas thus acquired were leased or sold by their owners. In that year free grants were abolished and all land belonging to the Crown had to be purchased at a flat rate which was at first fixed at five shillings per acre, and later increased by stages to twelve shillings and, ultimately, to one pound. As the chief requirement of the Colony was now labour to look after the flocks and herds, it was wisely decided to devote all revenue derived from the sale of Crown lands to paying the passages of shepherds, stockmen and other labourers who could not possibly bear the expense themselves. To the north, west and south of the settled area lay almost unlimited lands, about some of which explorers had brought back favourable reports. There was thus a great temptation for the fortunate possessors of flocks and herds to occupy this forbidden country. Forbidden it was to this extent, that its occupation was declared illegal and those who ventured into it were entirely denied legal and police protection. In spite of these restrictions there began about this time one of the most amazing periods in the history of the land industries. Adventurous young men, mostly free immigrants from England, Scotland and Ireland and sons of earlier settlers, started off into the practically unknown regions with their flocks and herds and settled down, or squatted, on areas of land which appealed to them. At first they chiefly followed the rivers flowing westwards, and the banks of the Macquarie, the Lachlan and the Namoi soon became studded with stations for distances of hundreds of miles beyond "the limits of location". As there were no fences in those days, natural features, such as creeks, hills and prominent rocks, were used to mark the boundaries between properties, supplemented by ploughed furrows where necessary.

Another line of march was northward from the Peel River,

following the tracks of Allan Cunningham. By 1832 Temple had squatted in the Walcha district on the fringe of the New England tableland. By 1835 settlement had reached as far as Armidale and thence it proceeded to Inverell, Glen Innes, Tenterfield, and, by 1840, to the Darling Downs, in what is now Queensland, where Patrick Leslie was the first settler. Within a few years the whole of this fertile region was fully occupied by large pastoral properties.

A parallel advance took place up the coast as far as the Clarence and connections were gradually established between the two northward movements.

To the south, Major Mitchell, the surveyor-general, in 1836 crossed the Murray with a general commission to explore the country to the west of the Australian Alps, and between the Murray and the sea. He reached the ocean at Portland Bay, where he was surprised to find the Henty brothers, who had come over from Tasmania two years before. Returning by a different route, he made a detour which brought him in contact with Batman's party on the shores of Port Phillip. Mitchell brought back news of the existence of the largest area of comparatively level and easily accessible pastoral country yet discovered, and the chief movement of settlement for the next few years was towards the northern and central portion of what is now the State of Victoria.

When the main rush to Queensland and Victoria lessened, attention was again attracted to the vast region west of Wagga and Albury in New South Wales. The next great movement was, therefore, along the banks of the Murrumbidgee and the country between it and the Murray and, although it had appeared to the earlier settlers too arid for profitable occupation, this new land of the Riverina proved to be one of the most suitable districts in the whole of Australia for the merino sheep. Stations even followed the course of the Darling upstream from its junction with the Murray and, although the rainfall was scanty and the carrying capacity light, it also proved healthy country for the hardy merino. Both sides of the river were gradually occupied by huge holdings as far as Menindie, and ultimately to Bourke.

The central portion of Victoria having been occupied, expansion took place westward to the Wimmera district, almost linking up with the South Australian settlement, and eastwards to the recently discovered, well watered and heavily timbered Gippsland country. In Queensland, too, the march of settlement

continued to the north of Brisbane as far as the Burnett and Mary rivers and right up to the Dawson valley. There is little exaggeration, therefore, in Roberts's statement that "by 1850 the squatters had already covered the face of Australia".

From the point of view of the immediate utilization of natural resources for the production of a marketable commodity, the squatting principle was excellent, and the exports of wool went up from two million lb. to over ten million lb. between 1830 and 1839. It, however, created many land tenure difficulties and problems. The squatters, although they acted illegally, were the real discoverers and pioneers of new areas, and it must not be thought that their lot was a particularly pleasant one. Indeed, it is difficult for people of the present day to realize the dangers and hardships they encountered as they pushed farther and farther into the unknown, hewing the tracks for the passage of their bullock-wagons, their flocks and their herds, with steep hills and unbridged rivers to cross, and the ever-present chance of encountering droughts, floods and hostile natives. In other respects their standard of living was not high, for their uncertain tenure prevented them for a long time from building decent houses or making other improvements. Hastily constructed bark huts had to satisfy them for dwelling-places, and the almost invariable diet of mutton, damper and tea must have grown monotonous. In the days before fences appeared, there were inevitable disputes with their neighbours and continual vigilance was necessary against the cattle-duffer and the sheep-stealer. One of their greatest difficulties was the obtaining of sufficient labour for the everyday work on the property, and especially for the busy shearing season. This was intensified when the transportation of convicts to New South Wales practically ceased in 1840. Many graziers were, indeed, driven to the cruel necessity of killing their lambs, as they could not get the assistance required to deal with their increasing flocks. Somewhat feeble attempts were made to import cheap labour from India, the New Hebrides and even Chili, but they were soon abandoned and reliance had to be placed on increased immigration from Britain. The regular routine since quite early days was for the shepherds to lead their flocks slowly to suitable grazing grounds soon after sunrise and bring them back into folds made by enclosing a space with hurdles at night, when they were placed in the hands of a watchman as a protection against wild dogs and thieves. Two shepherds and a hut-keeper were required for every thousand sheep. Extra hands were, of course, required at shear-

ing time and the usual remuneration was one pound per hundred, with an allowance of four glasses of rum per day. The work was all done by hand shears at an average rate of sixty to eighty per man per day.

It was a great annual event when the bullock-wagons were loaded up with the roughly packed bales of wool and started on their long trek to Sydney or Melbourne. Before they entered the capital they would be met by traders anxious to buy their wool and to sell them flour, tea and other provisions. This was the usual practice until Thomas Sutcliff Mort started his first sales of wool by auction in 1843. Labour shortage was not the only difficulty which confronted these pioneer squatters. The drought of 1829-30 was followed by an even more severe one about eight years later; the price of wool fell from two shillings a lb. to about one shilling, and an unprecedented commercial crisis developed which reached its maximum intensity in 1842 and 1843.

The drought and the fall in wool prices were not the sole causes of the trouble, which was brought about mainly by excessive speculation encouraged by a liberal extension of credit on the part of the banks. The Rev. Dr Lang's comments on the crisis are again forceful and illuminating:

> With these extraordinary facilities for all sorts of monetary operations, the rage for speculation not only in land and town allotments, but in sheep and cattle and horses, reached a much greater height than it had ever done during the "sheep and cattle mania" of the era of Sir Ralph Darling, and the most unbounded extravagance of living was in many instances the natural accompaniment of so unnatural a state of things. Everybody bought land and town allotments or sheep, cattle and horses at enormous prices, adopting at the same time a scale of domestic expenditure proportional to the profits they expected to realise and giving their promissory notes for due payment to the banks, or mortgaging their houses and lands to one or other of the Loan and Trustee Companies for sums not infrequently far beyond their real value.

The bubble soon burst; several of the banks failed; values came tumbling down to such an extent, for instance, that one flock of sheep was sold at sixpence per head to satisfy a small debt, and nearly everyone was reduced to a state of poverty.

In a report dated August 1843, Governor Gipps himself wrote:

> The principal features which distinguish the present State

> of New South Wales are (1) the extent to which insolvency has occurred in all classes of the community, even among men who were a short time ago considered in wealthy circumstances, (2) the great fall which has taken place in the price of every article of colonial produce, and even of articles imported into the Colony. Abundance and cheapness prevail throughout the land to an unprecedented extent, and consequently the cost of living is greatly reduced. . . . The expense of housekeeping in Sydney is not more than half of what it was three years ago. Doubtless the change is greatly in favour of persons coming to settle in the Colony and persons living on fixed incomes; but, on the other hand, wages are falling and persons who have nothing but colonial property, such as sheep, cattle, houses and land, wherewith to meet pecuniary engagements, are driven in crowds to the insolvent court. . . . The condition of several of the banks of the Colony is a matter which gives me great solicitude, three of them having already given way.

The position of the wool export trade, however, was inherently sound, and an Act was passed which enabled a debtor to continue in possession of his property if it was clear that he could ultimately pay. Recovery, therefore, was comparatively swift and there was probably full justification for the optimistic view expressed by Governor Gipps at the prorogation of Parliament towards the end of his term of office:

> I am happy in being able to declare to you my deliberate opinion that the Colony may now fairly be said to have overcome the difficulties against which it has so long been struggling, and that the continuance of good seasons is now only awaiting to ensure to the people of New South Wales success in all their enterprises, at least in all that are undertaken with ordinary prudence. The effect on individuals of past disasters may not, indeed, be altogether effaced, but I am satisfied that at no time during the period of eight years for which I have held the full administraton of this Government have the general affairs of the Colony been in a more healthy state than they are at the present moment. I greatly doubt, indeed, whether at any time in its past history the prospects of New South Wales were more favourable than they are now. The time, too, gentlemen, has arrived when, without a dread of impending reverses, I can allude to the extraordinary progress which, in spite of difficulties, dangers and many em-

barrassments, has been made by the settlers in all the recently occupied parts of our territory.

As a matter of fact, Governor Gipps had not at first looked with favour on the squatters in "the recently occupied parts of our territory" who had gone out beyond the surveyed area, but was finally convinced by the logic of facts that they must be given some sort of title to their land. This was particularly so when women had followed their menfolk into the bush and children began to grow up. It was therefore eminently desirable that they should have decent homes and schools and churches, and other amenities. It was finally decided to grant the squatters leases of their properties, and district commissioners of Crown lands were appointed to tidy up boundary questions and to see that no man got too large an area. Twenty square miles, or 12,800 acres, was the maximum area permitted in most districts, although the size was supposed to be correlated with carrying capacity. The net result was that the great bulk of the good pastoral land, and much that was suitable for agriculture, became locked up for a seemingly indefinite period.

The technique of the squatters and other graziers slowly improved, and three new ideas introduced about this period had a considerable effect on pastoral economy. The first of these had to do with the disposal of surplus stock by boiling them down for their fat or tallow. The suggestion is reputed to have come from Mr Ebbsworth of the Australian Agricultural Company, but was first put in practice evidently by Henry O'Brien of Yass in 1843. The sheep was first skinned and the carcass then cut up and placed in a huge cauldron with water and boiled till the fat could be readily separated, cooled and exported to London where it was in great demand. For an average sheep in fairly fat condition the net return for the skin and the tallow was at least six shillings. This made a big difference during the depression, when, as we have seen, sheep were sold for as little as sixpence each.

In a very short time 56 boiling-down establishments were in operation, some huge boilers taking 300 at a time, and in 1844 no fewer than 200,000 sheep were treated. The numbers grew to 750,000 in the following year, and to the almost unbelievable figure of 2½ million in 1850. Cattle were treated in similar fashion after the removal of the hide, and 260,000 head were prepared for the cauldron in 1850. Although the hind-quarters were frequently used for human food, and the residue for pig feed

or manure, the process which seems to modern ideas so wasteful, served a very useful purpose at the time and emphasizes the immense importance of the discovery of a commercial system of refrigeration and cold storage some forty years later.

The second new idea was the introduction of the practice of ring-barking trees by a fine old pioneer, Henry Badgery, about 1840. Many people wish that the practice had never been initiated, but it is its abuse, and not its use, that has to be deplored. Quite a large proportion of the occupied lands of Australia carried natural timber which, from the first, was a serious obstacle to the progress of both agricultural and pastoral pursuits. Killing the trees by ring-barking removes their competition with the native grasses for sunlight, water and plant food materials. The result in a year or two is to treble the carrying capacity and to make it very much easier to clear the land thoroughly for agricultural purposes. The work was generally done by contract, and the tragedy is that it was done in such a thoughtless and wholesale fashion that much timber which would have been valuable for constructional purposes was wasted. A still more serious result was that trees on hill-tops, ridges and steep slopes were destroyed, thus paving the way for the worst type of soil erosion. When not removed, these ghosts of the bush have a very depressing effect on many people. Nevertheless, where intelligently carried out, ring-barking made it possible to carry three head of stock where only one was carried before.

The third idea, fencing, introduced about 1850, was destined to have even more far-reaching effects. The fencing of small properties near Sydney had been practised since the early days, but it was a long time before the fencing of large grazing properties, running into thousands of acres, was regarded as a practical proposition. Amongst the first, if not the first, to adopt the practice on a large scale was the Australian Agricultural Company, on the eastern side of its Warrah property. The material for post-and-rail fences was readily available in most districts and, although the labour involved in their construction was great, it was soon found that the advantages more than compensated for the trouble and expense. They definitely settled boundary disputes and minimized the danger of cattle and sheep straying or being lifted. More important still, they helped to solve the ever-present labour shortage, for, instead of three men being required to look after 1000 sheep, several thousand sheep could be grazed in large paddocks, almost the only help required

being a boundary rider to make sure that the fences were kept in good order. The sheep thrived under the new system, developed a better carcass, produced more wool, and were much less liable to develop foot-rot and other diseases than when they were folded each night in a small space.

It was not till five years later that wire fences were started, and they soon became universal in the inland districts, as they are much lighter and cheaper and easier to make proof against sheep and rabbits.

CHAPTER VII

Progress Gains Momentum

THE early fifties of last century were notable for a number of events which had a great effect on the history of Australia. Some of them, like the granting of full self-government to both New South Wales and Victoria, the establishment of a national system of education, the foundation of the first Australian university, and the beginning of railway construction naturally took a long time to exert a great deal of influence. One, however, had an immediate and sensational effect on Australian economics, namely, the discovery of gold. It was not the value of the precious metal mined and exported which brought about the change so much as incidental happenings connected with it.

By 1850 the combined population of all the Australian colonies did not exceed 350,000, and the greatest need was a very substantial addition to these numbers. In spite of the attraction of a free passage, the number of immigrants was still insufficient for the urgent and ever-increasing requirements of the land industries. Moreover, the discovery of a gold-field in California in 1849 attracted quite a number of people away from Australia, and probably diverted others from their intention to come to Australia. Two years later the position changed entirely after the local rumours had been substantiated that gold had been found in payable quantity near Bathurst in 1851. The arrival of thousands of pounds worth of gold in Sydney caused great excitement, and the majority of the able-bodied men in the Colony who could possibly get away from their usual employment rushed off to try their fortune. It was not long before still richer gold-fields were discovered in Victoria at Ballarat and Bendigo, and the tide of migration turned southward. Apart from the loss to the land industries in the two Colonies where gold had been found, farms were abandoned in Tasmania, and adventurous young men who could ill be spared left their avocations in Queensland and South Australia to join in the rush. The news rapidly spread farther afield, with the result that

there arrived from nearly every quarter of the globe, as fast as the available ships could bring them, thousands of men attracted by the delusive vision of fortunes to be had with a minimum of effort. The gold magnet, indeed, proved the cheapest, and by far the most effective, immigration scheme Australia has ever had. Victoria benefited most; before the end of 1852 more than 70,000 men, mostly from the Colonies, were engaged in the search for gold within her borders, to be supplemented soon after by tens of thousands who came from Europe and America.

In 1840, when Victoria was six years old, she had a population of about 10,000. Ten years later this had increased to 76,000 through the development of her pastoral and agricultural resources. Then came the gold rush, and the numbers went up to 364,000 in 1855—more than the total population of Australia five years before. The immediate effect on the land industries of all the Colonies was disastrous, as indispensable labour was attracted away from them and the greatest difficulty was experienced in getting the sheep shorn, the grain sown and the harvests gathered in. For a time agriculture could not nearly cope with the great increase in the demand for food, and imports of grain had to take place on a large scale. In the long run, however, the rural industries benefited greatly, as a large number of disappointed miners took up agricultural pursuits, especially in Victoria. Those who had left the land soon began to realize that it was a sounder proposition to grow cereals and vegetables and to produce butter and eggs and meat at inflated prices, than to chance their luck on the gold-fields. It was a considerable time, however, before the re-adjustment took place, and the labour scarcity on the land continued for some years. In consequence of the recommendations of a select committee, fuller encouragement was given to agricultural immigration, not only from Britain, but from Germany, Italy and other parts of the continent. The latter immigrants, who were asked for to develop special industries like fruit culture and viticulture, proved very desirable settlers and added variety to agricultural production. A large number of Chinese were also introduced to supply labour for the rural industries, but they had not long been here before the majority of them drifted to the gold-fields. When they ultimately returned to the land, they generally concentrated on vegetable-growing, using the laborious methods they had been accustomed to in their native land. Such intensive methods did not suit the temperament of the majority of Australians, and for several decades Chinese market gardeners in the neighbourhood

of cities and towns were largely responsible for the supply of all types of vegetables, with the exception of potatoes which could be grown on a field scale.

In spite of the labour shortage, pastoral and agricultural progress continued at a steady rate in all the Colonies. Between 1856 and 1860, for instance, the area under crop in New South Wales increased from 186,000 acres to 260,000 acres, and a good deal of it represented more intensive and diversified use of the land than heretofore. By 1860 the total population of Australia had grown to over a million. In spite of the much larger number slaughtered for human consumption, and the drain caused by the boiling-down cauldrons, the cattle had increased to four million and the sheep to twenty million, the vast majority being of the pure merino breed.

Besides the scarcity of labour there were two factors which were hampering progress, namely the slowness of railway development and land tenure difficulties. We have already seen that the bulk of the desirable land in New South Wales had become the monopoly of large graziers and squatters. With the growth of population and the development of towns and villages at various places throughout the State, partly as the result of the finding of gold in scattered locations, the demand for small properties to be devoted mainly to agriculture increased rapidly. In 1861 Sir John Robertson introduced his much discussed "Free Selection before Survey" Bill with the object of meeting this situation. It was probably the most liberal land Act ever passed in any country, as it practically allowed anyone to select land anywhere without even a preliminary survey, provided four conditions were fulfilled.

1. The area must be not less than forty acres and not more than 320 acres.
2. The price of the land was fixed at one pound per acre, five shillings to be paid down, the remainder by instalments.
3. The selector must reside on the property.
4. Improvements must be made to the value of one pound per acre within a specified time.

There is little wonder that selections were in great demand, especially by disillusioned gold-seekers, but it is quite understandable that the movement was not popular amongst the squatters. Anyone could select, even a young child, so that a man with a large family could obtain quite a considerable area. The selectors might be divided into three classes:

1. The genuine workers who were anxious for a life on the land. This was really much the most numerous class, although they did not get the publicity of the other two.
2. Those who took up selections in order to interfere with a squatter's property, either through spite or, more often, in the hope of getting a reward for going away. There were many cases, for instance, of land being selected by a group in a narrow strip along a river bank to prevent a squatter's access to his main supply of water. This was popularly spoken of as peacocking.
3. The dummies employed by the squatters. In order to minimize the danger of peacocking reducing the value of his holding unduly, the squatter would get a number of his own employees to select blocks in strategic positions, and they would get a suitable reward for allowing their areas in reality to be worked in conjunction with the main property as formerly.

In spite of the bad feeling aroused between the squatters and the free selectors and the underhand work on both sides, the Act did a great deal to facilitate settlement in smaller areas and to bring about a better balance between the agricultural and grazing industries.

In Victoria, with its smaller area and larger population, closer settlement and agricultural development proceeded still more rapidly, while the comparatively small proportion of South Australia, with a rainfall of over ten inches per annum, encouraged rather intense agricultural development in the favoured southern districts, with large-scale grazing in the more arid north. In Queensland, with its large area of grazing land still unoccupied, the northward and westward march of the squatter with his herds of cattle, as well as his flocks of sheep, was still the predominant feature of rural development. It was gradually realized that much of the northern part of this huge Colony, owing to the incidence of the rainfall and the nature of the pastures, was much better suited to cattle than to sheep, and it soon developed into the leading beef-producing Colony.

In each of the southern Colonies there gradually emerged a number of stud-breeders who aimed at the improvement of the merino as a wool-producing machine. Macarthur and his successors had concentrated on the fineness of the wool fibre somewhat at the expense of other desirable qualities. Indeed, Macarthur's original strain, which has been carefully preserved

at Camden Park up to the present day, was a small-framed active animal, with a comparatively light covering of short but very fine wool. Several rams imported from France and Germany and later from America, together with careful selection by the breeders, had an effect in increasing the size and improving the carcass and the length and covering of the wool right down the legs and over the face.

Stud breeders of Shorthorns, Herefords and Devons were rendering a similar service to the cattle industry.

In spite of the minor disturbances to the pastoral industry through Sir John Robertson's Act, it made just as great progress as agriculture in the period following the gold rush, fencing, ring-barking, the improvement in the yield of wool per sheep by better breeding methods and disease control being the most important contributing factors. Both sheep and cattle in Australia had been free from many of the ailments which affected the livestock of Britain and the continent of Europe. There were two maladies affecting sheep, however, which had given serious trouble since the earliest days, namely, sheep-scab and foot-rot. Their importance was considerably reduced as the fencing-in of the properties eliminated the necessity for folding the animals at night. Foot-rot persists to the present day, though its incidence has been greatly reduced through the recent discovery of the causal organism.

Great credit is due to the graziers and their advisers for their success in the battle for the elimination from Australia of sheep-scab, an irritating trouble caused by a tiny mite. The general principles adopted were veterinary police measures combined with preventive or curative treatment. An Act was passed in 1832 to control the movement of affected sheep, but evidently the measures taken to enforce it were not very satisfactory. The Act was amended in 1863, setting up district boards to enforce the regulations rigidly, and no sheep were allowed to travel without a certificate of freedom from the disease.

With regard to treatment, many specifics were used in the early days with moderate success, but the ultimate cure came in the compulsory dipping of all affected or suspected sheep with a mixture of tobacco extract and sulphur, or with a lime-sulphur solution. As the sheep passed through the dip they were submerged twice, and the treatment was repeated after an interval of ten to twenty days in the case of moderately affected sheep, with a third dose for those badly infected. In the incredibly short period of three years after the passing of the amended

Act, New South Wales was declared to be entirely free from scab. In the same year (1866) Queensland and South Australia were also declared clean, although it was several years before Victoria, Tasmania and Western Australia got a clean bill of health. Strict quarantine regulations have succeeded in keeping the disease out of Australia ever since, with the exception of an occasion in 1884, when a consignment of stud sheep from America escaped the vigilance of the quarantine officers in Sydney and were found to be affected with the disease when they reached their destination at a station near Carcoar belonging to H. G. Lomax. Lomax deserves great credit for identifying the disease and immediately advising the authorities, as he knew what troubles he might have to encounter in consequence. Very prompt action was taken. The station was quarantined, the American sheep and the local sheep they had contacted were slaughtered and burned. The wool-shed in which they had been housed, as well as two miles of fencing and 2000 acres of grass, also went up in flames, and other precautions taken, with the result that the disease was stamped out and thus one of the greatest drawbacks to the progress of the sheep and wool industry finally eliminated.

CHAPTER VIII

A Disastrous Invasion and an Epoch-making Discovery

JUST about the time the scourge of sheep-scab had been successfully removed from New South Wales, a new trouble was appearing on the horizon. A few rabbits, as we have seen, arrived with the first fleet and several were imported at intervals thereafter, but they were of the tame domesticated type, and there is no evidence that they ever got out of hand or did any serious damage.

On Christmas Day 1859 there arrived in Melbourne, by the clipper *Lightning*, a cargo which included 24 wild rabbits consigned to Thomas Austin of Barwon Park, near Geelong, introduced evidently for sporting purposes. Now the wild rabbit does quite a considerable amount of damage in a closely settled country like England, where it has quite an array of natural enemies such as stoats and weasels, owls and other birds of prey, as well as being kept in check by poachers and by town-dwellers who like to amuse themselves with guns on week-ends and holidays. It is quite a different proposition when introduced into a huge sparsely populated country like Australia, possessing practically no natural enemies; and as its rapid breeding habits are proverbial, it seems strange that no one at first evidently recognized the potential danger. There may have been other introductions of the wild rabbit to Australia, but it is generally agreed that this Geelong consignment was the main source of infection. From the progeny of the two dozen harmless-looking bunnies, Austin is stated to have killed on his property 20,000 in the first six years, while he estimated that about 10,000 still remained. Even this was probably an under-estimate, as a mathematical friend of mine has calculated that the possible progeny of two rabbits at the end of two years would be more than 65,000.

With a practically unlimited supply of food available, their progeny spread northward and westward with alarming rapidity,

disfiguring the countryside with their burrows and seriously reducing the value of the pastures for grazing stock. In less than twenty years they had reached and crossed the Murray River and gradually extended their domain into New South Wales and South Australia. By 1886 they had infested most of the plain and partially cleared country in western New South Wales and reached the Queensland border, and, in spite of every effort to control them, they are to be found now in every part of Australia outside the tropics and the really desert regions—well over a million square miles—and it is almost impossible to exaggerate the damage they have done.

In the better and medium rainfall districts, with a high carrying capacity, many land-holders have succeeded in keeping their properties practically free of the pest by the use of wire-netting fences around their boundaries, digging out the burrows and hunting the stragglers with dogs. A good income is made by trappers in the cooler districts and seasons where the skins have most value, but the reduction of total numbers by this method is almost negligible. In broken and rocky country it is practically impossible to construct boundary fences which are entirely rabbit-proof, and in districts with a low carrying capacity it is not economically feasible. Fumigation of the burrows and the use of the poison cart are frequently adopted, the former being preferable for a variety of reasons. Experiments were carried out with the object of eradicating them by the introduction of contagious diseases, with rather disappointing results at first. In spite of all these agencies, the problem which first confronted the pastoralists of eighty years ago was until quite recently a very serious one. Most damage, perhaps, is caused in the lower rainfall districts, where the rodents not only reduce the carrying capacity, but, by ring-barking the young trees and eating out the bulk of the vegetation, they may remove the soil covering to such an extent that wind erosion becomes very serious indeed —hence the popular saying that "rabbits create deserts".

From time to time in the history of any country a man appears who, by his mental capacity, vision and enterprise, contributes very greatly to its progress and prosperity. Such a man was Thomas Sutcliff Mort. Although his statue standing in Macquarie Place, Sydney, shows that his achievements were recognized by his contemporaries, it is feared that the present generation knows too little about what it owes to him. He was born at Bolton, Lancashire, in 1816 and arrived in Sydney at the age of

22, taking a position with a commercial firm which came to grief in the commercial crisis of the forties.

In 1843, when the depression was at its height, he set up business as an auctioneer and was actually the first man to sell wool by auction in Australia. This activity gradually evolved into the well-known firm of Goldsbrough, Mort and Company Limited. He was one of the promoters of the company which started railway construction in Australia, although the completion of the first line from Sydney to Parramatta was afterwards taken over by the government. He founded engineering works at which the first Australian locomotives and other railway plant were manufactured. These were subsequently enlarged to include shipbuilding and repairing, and in this connection he established the first dry-dock in Australia. This enterprise has greatly extended and is still flourishing as Mort's Dock and Engineering Company Limited. On his estate at Bodalla, near Moruya, he was one of the first to develop a large-scale dairying industry, with its own butter and cheese factories, the produce of which gained a high reputation for quality, and he took part in the promotion of various mining companies. His greatest contribution by far, however, was the prominent part he played in developing the first successful system of commercial refrigeration anywhere in the world. His main ambition, which was almost an obsession, was, in his own words, to find an answer to the problem "how safely, simply and economically to carry animal food in a perfectly natural condition from one country to another".

In a land which experiences such high temperatures as Australia, ice for cooling purposes is not merely a luxury, but a necessity, and natural ice was imported from America as early as 1839. This was kept in insulated ice-houses and used mainly by purveyors of cool drinks. The first manufacture of artificial ice in Australia was carried out by James Harrison, a journalist, legislator and businessman from Geelong, who took out a patent in 1856 for the manufacture of ice by taking advantage of the latent heat of evaporation of ether. In 1873 Harrison experimented with a process for the freezing of carcasses, but it proved a failure in practice.

Beyond doubt the evolution of a practical system of refrigeration and cold storage is due to a combination of the brains, capital and resourcefulness of two men, E. D. Nicolle and Thomas Sutcliff Mort.

Nicolle was a skilled engineer who rose to be general manager

of the well-known engineering firm of P. N. Russell and Company. He later started on his own account and experimented with an ice-manufacturing process dependent on the evaporation of ammonia, for which he secured a patent in 1863. It proved very successful and for several years he supplied Sydney with ice, and even exported it to Brisbane and far-off Rockhampton.

In 1867 he was introduced to Mort, who explained his ambition to export frozen carcasses to Britain and the continent of Europe. It was a fortunate contact, and for over seven years, in a small factory in Darlinghurst, they worked at their experiments with this end in view. The problem was to get a continuous temperature below freezing-point for an indefinite period, and they finally solved it by a mechanism which enabled the evaporating ammonia to be used over and over again.

Large freezing-works were established at Darling Harbour, and slaughterhouses erected at Lithgow in preparation for the dispatch of the first cargo of frozen beef to Britain. It is sad to think that Mort did not live to see the culmination of his life's work. In 1878 the ship *Northam* was chartered to take to Britain a refrigerated cargo valued at £100,000. Unfortunately, the necessary machinery could not be fitted up on board within the time limits of the charter and the ship had to sail without her cargo. Mort died at Bodalla later in the year, his death probably hastened by this great disappointment and the strenuous work of the preceeding years. It was not long, however, before success attended the patient efforts of these two fine men; for in the following year the steamship *Strathleven* sailed for England with a cargo of frozen meat, which was successfully landed in London in February 1880 and readily sold at one shilling to 1s. 6d. per lb.

Mort's refrigeration plant was purchased by the Fresh Food and Ice Company, who continued to use the ammonia process patented by Mort and Nicolle, and the frozen meat export trade was soon put on a sound foundation. Other companies soon started to establish freezing-works in Australia, such as the Australian Frozen Meat Export Company of Marybyrnong and Newport, Victoria, which started operations in 1880. Farther north the Central Queensland Meat Export Company added a freezing-plant to its equipment in 1883 and was responsible for the first Queensland cargo of frozen meat which left Moreton Bay in May 1884, and several other large companies followed their example. The benefits of the process soon spread to New

Zealand, which improved the technique and took still further advantage of the discoveries.

Australia, and the world in general, undoubtedly owe an immense debt of gratitude to E. D. Nicolle, and especially to Thomas S. Mort, who is said to have spent no less a sum than £100,000 on his experiments. They worked very harmoniously together, as is evident from a passage from an address given by Nicolle at a meeting of the Agricultural Society of New South Wales. After expressing his "sincere esteem and admiration for Mr Mort", he said, "Few men have toiled together and passed through such a labyrinth of difficulties as we have during eight years. Had it not been for his liberality, energetic enterprise and love of progress, we should not have reached our present stage of advancement, but it is gratifying that science sometimes finds its disciples amongst such noble minds who willingly sacrifice pleasure, rest and even fortune for her cause."

The establishment of the frozen meat industry came at an appropriate time, as the demand for beef and mutton at a reasonable price in the United Kingdom was increasing rapidly, and in Australia the livestock numbers were growing much more quickly than the human population. The increased returns to stock-owners, as compared with the wasteful boiling-down process, meant greater prosperity for the country as a whole. The advantages of refrigeration were not, of course, confined to the export of frozen beef and mutton. It was of immense value to the dairying industry, as it made possible the successful manufacture of good quality butter in warm districts and seasons. It also enabled dairy products to be held in store for months and to be exported to Britain and other countries without any appreciable deterioration. The export of eggs, fresh fruits and other perishable commodities would be impossible without it.

Some idea of the benefits of refrigeration to Australia may be gleaned from the value of her exports of frozen goods in 1938-9, which included £15 million worth of dairy products, £10 million worth of beef, veal, mutton and lamb, £3¾ million worth of fresh and processed fruit, and £1 million worth of pig products, to say nothing of ten million dozen eggs and about £250,000 worth of rabbits.

CHAPTER IX

The Role of the Stud-breeders

IT would be impossible in this brief review to do justice to the invaluable part played by the stud-breeders and their advisers in bringing about the remarkable improvement in the merino in Australia and especially in the average yield of wool per sheep, but something of the story must be told. Up till 1820 Macarthur's Camden Park sheep practically stood alone as the stud merino flock of Australia. Not long after that a rival appeared in Cox's Havilah stud in the Mudgee district. Cox followed along the same lines as Macarthur with all the emphasis on fineness of fibre. The same objective was in the minds of the Australian Agricultural Company, which made valuable importations, chiefly of the Saxon type. When land could be obtained as a free grant, provided that the owner undertook to maintain a certain number of convicts, the yield of wool per sheep did not matter very much and there was little incentive to go for quantity. When, however, free grants were abolished, the return per sheep became of greater importance, and more attention had to be paid to the average weight of the fleeces in a flock. N. P. Bayly, who succeeded Cox and William Riley, also of the Mudgee district, concentrated largely on improving the density and covering, whilst retaining the quality of the wool. With this end in view the latter imported Saxon merino sheep from the famous Raby stud in Germany in the early thirties, and both succeeded in their objectives. Indeed, the Mudgee district supplied the New South Wales and Queensland squatters with the majority of their flock rams for several decades. Rival breeders, however, soon attracted attention in each of the other southern colonies. In Victoria the Cumming brothers of Stony Point in the western district came to the fore with rather larger framed sheep with higher yields of wool of longer staple and excellent quality, and their example was later followed by the Learmonths of Ercildoune and other breeders of lesser note. Then in Tasmania two famous studs were being developed by the Gibson brothers of Scone and Bellevue, and their rams for a considerable period brought the highest prices

at the Melbourne and Sydney sales. The Tasmanian sheep were of the same general type as the Victorian, but gave an even higher yield of wool of excellent quality. Indeed, it is doubtful whether any merino up to the present day greatly excels the best of their rams in the combination of length, density and fineness of staple. Except in South Australia, the Mudgee, Victorian and Tasmanian fine-wool studs were much the most prominent in the merino world for many years, and it is noteworthy that it was during this period that Australian wool firmly established its great reputation in Britain and on the continent of Europe. All of these stud-breeders were located in districts with a comparatively good rainfall, and the sheep bred there did quite well in the early days, when a large proportion of the occupied land had a rainfall of twenty inches or over.

Conditions were quite different in the greater part of the pastoral area of South Australia, with its scanty precipitation, hot dry summer winds and low carrying capacity. Here a rather different type of sheep was required, and the necessity produced the inspired breeder in the person of John Murray of Mount Crawford. His sheep were longer in the leg, larger in the frame and longer and coarser in the wool than the eastern types—all suggesting a slight infusion of Lincoln blood. He started operations in 1843 (only seven years after the foundation of the province) and he and his successors are stated to have carried on the stud for a century with only a negligible infusion of outside strains. Their hardiness under dry conditions and the weight of the scoured fleece largely compensated for the reduction in quality and price per pound. Murray soon had a serious rival in C. B. Fisher of the Levels, who founded a stud of the same general type in 1854. Levels rams became popular in western New South Wales as well as in South Australia, and were used successfully on Fisher's Queensland stations.

For a very large area of country on the western slopes and plains of New South Wales, northern Victoria and southern Queensland, an intermediate type appeared to be required, and this was ultimately produced by the Peppin brothers of Wanganella in the Riverina, to whom the pastoralists of Australia are more deeply indebted than to any other breeders since Macarthur. They came from England, where their father had had some experience of the merino, as he possessed a few which were the offspring of the royal flock. They first settled in Victoria, where they were not particularly successful. They then bought Wanganella station in the Riverina in the late fifties. Again they

at first met with disappointment owing to the erratic seasons and shortage of water, and they actually tried to sell the property in 1861, but could not get an offer for it. They then decided to try to breed a type of sheep more suitable for their particular climatic conditions of rather low rainfall and hot summers, where the animals had often to travel considerable distances for food and water. Like Murray and Fisher, they realized that they had to sacrifice extreme fineness of fibre and they succeeded in producing a type with longer and stronger wool than the prevailing Victorian, and yet possessing something approaching it in crimp and style. In 1861 they started a stud flock at Wanganella and later at Boonoke with 200 ewes of their own breeding and some from Canally in the Balranald district, which were distinctly of the South Australian type. Amongst others they imported two rams of great merit as sires, one from France and one from the United States. Most publicity has been given to the former—the Rambouillet ram Emperor—which has been described as "the father of the modern wool industry in Australia", but some people consider that the plain-bodied Vermont ram Grimes was just as potent an influence on the development of the famous Wanganella strain.

Two distinct groups were kept at Wanganella, one the in-bred progeny of Emperor and the other the in-bred progeny of Grimes. Ewes of each flock were kept separate and some of them mated with rams of opposite breeding. The ultimate result was the production of an attractive uniform strain possessing a large square (for a merino) symmetrical frame with characteristic neck-folds and an extensive covering of long dense medium wool. Peppin sheep became very popular in their native Riverina, and their fame soon spread throughout the country, and it seems rather tragic that the Peppins sold Wanganella and their flock just as they were reaching the most profitable stage. Fortunately the flock was not broken up, as the sheep passed into the hands of Austin and Millear, who bought Wanganella, and G. S. Falkiner, who purchased Boonoke, and they carried on the good work along the same lines as the founders of the strain.

The beneficial influence of the Wanganellas would have been more rapid and widespread had it not been for what now seems a curious aberration on the part of the merino breeders of Australia. The pastoralists were continually on the look-out for means whereby the yield of wool per sheep could be increased, and importations of rams from abroad became more frequent with this end in view. It would probably have been better to

concentrate on improvement by breeding from the best Tasmanian and Victorian sheep for the districts suitable for the production of fine wool, the best of the South Australian type for the far western plains, which were adapted for strong-wool production, and the Peppin strain for the intermediate country.

The biggest pastoralist in Australia, Sir Samuel McCaughey, who at one time possessed over $1\frac{1}{4}$ million sheep, owned or leased many properties in New South Wales, several of them in the western districts. He stuck in the main to fine-wool sheep of the Mudgee and Victorian type, and bred his own flock rams at Coonong near Wagga. As already indicated, such sheep are not well adapted to the drier warmer country, and he tried the introduction of Peppin blood in the early eighties with rather disappointing results. He was much impressed by the success achieved by his neighbours, the McFarlands, through the introduction in 1881 of the ram Matchless from the United States, and when a number of other American merino rams arrived in Sydney for sale, he bought ten of them, the most notable being Daring, a large-framed ram with a very dense fleece, and was very pleased with the results of the matings with his Australian-bred ewes. In 1889 he made a special trip to the United States and spent £50,000 on Vermont rams. Now Matchless had a smooth skin and even Daring was comparatively plain-bodied, but most of his purchases in America had quite pronounced wrinkles. It seems that in Vermont they had recently been breeding for a loose skin with pronounced wrinkles in order to increase the wool-bearing surface, and many of their rams cut heavy fleeces, which greatly impressed the visitor from Australia. Very soon nearly all the sheep-breeders in New South Wales and a great many in Victoria and Queensland went Vermont mad, and right up till the end of the century extensive shipments of Vermonts arrived, as the graziers had such confidence in McCaughey's judgment. More tragic still was the way in which the fine Tasmanian stud-masters, who were producing such splendid animals, fell into the trap. The show-ring magnified the mistake, as it was no use showing sheep unless they were literally covered with wrinkles all over their bodies. This was the state of affairs right up till the end of the century and a few years later.

It was gradually realized that a mistake had been made, and it is remarkable that there was not more serious opposition to the fad from its beginning. The high weight of fleece was largely deceptive, as it contained so much grease that the scoured weight

of the best ram fleeces was not usually as high as that of the Wanganellas. On the whole, they had not such vigorous constitutions and the disastrous drought early in the new century found them out. In addition, they proved much more susceptible to blow-fly attack and presented obvious shearing difficulties.

The wrinkly Vermonts are estimated to have affected ninety per cent of the leading flocks of New South Wales, Queensland and Tasmania. Fortunately a sufficient number of breeders kept the Victorian fine wools, the South Australian strong-wools and the medium-wool Wanganellas free from wrinkles, and they came into their own again with the waning in popularity of the Vermonts, although some prominent breeders of the present day profess to like a little "development", as the wrinkly skin is now somewhat apologetically described, in their sheep.

Whilst the bulk of the improvement in the merino is usually attributed to the actual owners of the most prominent studs, it should not be forgotten that they were greatly assisted in their work by professional wool-classers and flock-classers. The names of many of these benefactors were never known to the general public, but special mention must be made of Thomas Shaw and his son Jonathan. The former had probably more to do with the improvement in the quality of Victorian wool in his day than any other individual, while Jonathan is said to have classed with amazing celerity all the flocks worth classing in Victoria and the Riverina in the seventies and eighties, including those at Wanganella and Boonoke. Theirs were almost the only prominent voices raised in opposition to the Vermonts which they described as soap sheep on account of the high percentage of grease in the wool.

Whilst the breeders mentioned were perhaps the most important, there were many other studs which contributed to the improvement of the merino in the later decades of last century, such as those at Collaroy, Cunningham Plains and Springfield in New South Wales, Carngham and Larra in Victoria, Canowie and Bungaree in South Australia, Pikedale and Talgai in Queensland and Winton in Tasmania.

Although the climate and pastures of Australia have proved very suitable to the merino breed, the main credit for the improvement in the yield of wool per sheep must be given to a remarkable succession of skilled stud-breeders and their advisers. The extent of the improvement is illustrated by the following facts and figures. John Macarthur seemed very pleased if the best of his merino rams gave a clip of five pounds of wool, while

his flock average in 1820 was less than 2½ pounds. Before the end of the century the average weight of fleeces in Australia of both sexes and all ages was in the neighbourhood of seven pounds, or more than two and a half times Macarthur's average, and individual rams gave the astounding yield of nearly forty pounds, or about eight times as much as Macarthur's best rams.

CHAPTER X

Progress of the Beef-cattle Industry

WHILST sheep and wool took pride of place in the utilization of the large areas of undeveloped land in the new continent, cattle-breeding also played a prominent part, many of the settlers combining the two industries. In the early days bullock teams were the chief medium of transport, and when ploughs and harrows gradually replaced spades and hoes for the cultivation of the land, bullocks were the main source of power also. They were preferred to horses because the latter were scarcer and dearer and mainly light breeds more suitable for riding and driving than for draught purposes. Bullocks, which received nothing more than grass, were cheaper to feed and, if any were injured, they could be fattened for the butcher.

Most of the cattle introduced in the earliest days from South Africa or India were of the zebu type, with a hump on the shoulders and prominent dewlaps, and were better suited for draught purposes than for the production of either beef or milk. By degrees nearly all the prominent British breeds of both beef and dairy cattle were introduced and used mainly at first for crossing with the early arrivals, with the result that the abnormalities gradually disappeared. A few prominent men developed small herds of pure-breds. John Macarthur and his nephew Hannibal started herds of Longhorns, a dual-purpose breed now almost extinct. The former afterwards transferred his affections to the North Devons. His example was followed by Captain Kent, Sir John Jamison, Atkinson, Howe and Charles Reynolds of Tocal on the Paterson River, who afterwards became the pioneer Hereford breeder. The result was that for a time the North Devon was the most prominent breed in the Colony.

A notable event was the importation of some pure-bred Shorthorn or Durham cattle by Thomas Potter MacQueen of Segenhoe in the Hunter River district, followed by larger importations of the same breed by the Australian Agricultural Company, as they were soon to be the leading beef breed of Australia because of their excellent all-round qualities and popularity with the

butchers. Rev. Samuel Marsden brought back with him from England some specimens of the Lincoln red Shorthorns, which were better milkers and more of the dual-purpose type. A few red Sussex cattle were also introduced. They are somewhat similar to the Devons, but rather larger and stronger and actually the last breed to be used for draught purposes in England.

Some very good Herefords were imported into Tasmania in the early days, and Charles Reynolds and some of his friends in the Hunter valley used the progeny of these as their foundation stock. This breed has proved particularly well adapted to the extensive grazing areas of Australia, and it is worthy of note that the Reynolds family have been amongst the most prominent Hereford breeders right up to the present day. The "battle of the breeds" resulted in a victory for the Shorthorns, with the Herefords second in importance and the Devons a long way behind, and this order of preference continued to the end of the century. Quite a large proportion of the beef cattle of Australia are still the result of either planned or indiscriminate crossing, and the cattle industry owes almost as great a debt to her skilled stud-breeders for the supply of pure-bred sires as their confrères in the sheep and wool industry.

In the early days of the Colony, as has been indicated, the larger land-holders combined cattle-raising with shepherding. As flocks and herds increased, larger areas became necessary, since they were chiefly grazed on natural pastures amongst the standing timber, and the carrying capacity, especially in dry seasons, was not very great. The stock-owners were therefore forced into using unoccupied lands in the interior. Having found a tract of land which appealed to them, they made application to the government for permission to occupy it. They would then be provided with a ticket of occupation for a small annual payment. A common limit to the size of the new area was "two miles in every direction from the stockyard", subject to six months' notice if the land was required for permanent settlement. The land was, of course, unfenced and great trouble had to be taken to ensure that the cattle did not stray from the property. One or two men would be put in charge, and the first requirements were the provision of huts and stockyards, with perhaps a few pens for the younger calves. The cattle for the first few days would be herded together and confined to the stockyards at night. The stockmen on horseback would take them out for grazing during the day, confining them to the limits of the

selection until they got accustomed to their surroundings. Thereafter they would be yarded every second night, then twice a week, then once a week and so on till they gradually got used to the limits over which they could graze with a minimum of supervision. This arrangement was not entirely satisfactory, but was good enough as a temporary measure. When permanent areas were granted or purchased, fencing became a practical proposition and the routine greatly simplified. Under these conditions the numbers increased rapidly and soon exceeded the demand for working bullocks and meat for the slowly growing population. As there was no market outside Australia, except what was required for the provisioning of ships, by 1830 the average value, accentuated by the after effects of the sheep and cattle mania, dropped from about ten pounds per head to about ten shillings, so that the drought of that period was not an unmixed evil. When the real march of the squatters began, the numbers increased still more rapidly, until by 1843 there were over a million cattle within New South Wales alone. Boiling-down brought considerable relief to the surplus problem, as it did in the case of sheep, but the final solution did not come until the introduction of refrigeration in 1880.

The cattle of Australia have been relatively free from many of the diseases which affect the stock of Europe, Africa and Asia, thanks to our great distance from sources of infection and to stringent quarantine regulations. Two of the most dreaded of these–rinderpest and foot-and-mouth disease–each on one occasion gained entrance, but fortunately they were soon stamped out. Two others, however–anthrax and contagious pleuropneumonia–gained a permanent footing in the interval between the starting of boiling-down and refrigeration. The former appeared in the county of Cumberland in 1847, where many cattle as well as sheep and a few horses died suddenly from a then unknown cause. A commission appointed by the New South Wales Government in 1851 reported that the symptoms were analogous to those of a disease known in France as *maladie du sang* (anthrax) and recommended the burning of the carcasses of the animals which had died of the disease and prohibiting the movement of stock from affected areas. Unfortunately these recommendations were not carefully carried out and the disease got over the mountains and spread extensively in New South Wales and Victoria and, to a less extent, in Queensland. A successful method of innoculation against anthrax, discovered at the Pasteur Institute in Paris and a modification of it introduced into Australia by

Gunn and McGarvie Smith, together with quarantine measures and the burning of affected carcasses have gradually reduced it to almost negligible proportions. For a time, however, it took a heavy toll of sheep as well as cattle, especially in southern New South Wales and northern Victoria.

Contagious pleuropneumonia was evidently introduced by a cow imported into Victoria in 1858. She died six weeks after landing, but in the meantime infected other cattle, including a team of working bullocks which disseminated the disease very widely. Before long it became extremely serious throughout a large part of Victoria, New South Wales and Queensland, causing heavy mortality. In New South Wales, for instance, the number of cattle dropped from 2,620,000 in 1862 to 2,023,000 in 1864. Although it still persists on some station properties in Queensland and there are occasional outbreaks in the southern States, it has been practically eradicated from Victoria and New South Wales by methods similar to those used against anthrax.

It is to be feared that the majority of the squatters did not pay very much attention to the quality of their herds, as their main interest was in sheep. The more progressive, however, periodically purchased good Shorthorn or Hereford bulls from the stud-breeders of the Hunter valley, the western district of Victoria and other favoured localities. It would be difficult to enumerate all the stud-breeders responsible for the improvement of the beef Shorthorn in the later decades of the century, but amongst the most prominent were the Robertson brothers of Colac, Victoria, Woodhouse of Mount Gilliad, Campbelltown, and the Jenkins family of Nepean Towers in New South Wales, whilst the Reynolds family continued to have the greatest success as breeders of Herefords.

Some of the squatters realized that their newly acquired country was more suitable for cattle than for sheep and concentrated on the former. This was particularly true of the districts near the coast in New South Wales and Victoria and a large part of Queensland. Their general methods of management were rather primitive, the stock having to be satisfied with what nature provided, and this was very variable in quantity as well as in nutritional value, with changing seasons and wide differences in the incidence of the rainfall. Ring-barking and subdivisional fencing increased the general carrying capacity as far as food was concerned. The water supply, as in the case of sheep, was an all-important limiting factor in dry years. Fortunate were the owners of properties through which flowed rivers

THOMAS SUTCLIFFE MORT

The father of refrigeration.

WRINKLY MERINO

The popular type at the turn of the century.

and creeks or which possessed permanent springs. Large earthen dams or tanks were constructed to catch run-off water, and windmills were erected wherever underground water existed at a reasonable depth. The discovery and utilization of artesian water over a very wide area of western Queensland and north-western New South Wales made a tremendous difference to many properties. By far the largest number of cattle before the end of the century were to be found grazing on the pastoral leases of Queensland, and many of the holdings were of very large size. Most of these were in country with a moderately copious and reliable summer rainfall.

The development of the cattle and allied industries in an immense area of low rainfall country in south-western Queensland, north-western New South Wales and the dry northern parts of South Australia stretching into the Northern Territory, is almost entirely due to one rather remarkable man, the late Sir Sidney Kidman, who became universally known as "The Cattle King". He was born in 1857 on a small property near Adelaide, and his father, who had come out from Suffolk eight years earlier, died when Sidney was six months old. His elder brother, who had had droving experience in the interior, evidently fired his imagination, for at the age of thirteen he invested all his savings in a saddle-horse, which cost him fifty shillings, and some necessary riding gear, and made his way towards a distant station in New South Wales. His horse knocked up before he had gone very far, but he ultimately arrived at Mount Gipps station near Broken Hill, where he was employed at ten shillings a week. When he had increased his experience and proficiency he asked for a rise, with the result that he was dismissed. He proceeded to another station, however, where he was employed at a pound a week. A year or two later he had saved enough money to buy a bullock team and became a carrier between Wentworth and Wilcannia. Shortly afterwards he went to the budding mining town of Cobar, where he acquired a butcher's shop and continued his transport operations, carting copper ore from, and provisions to, that somewhat isolated township. While at Cobar he acquired a free selection of 140 acres in partnership with another man—the first land he ever owned. He sold his butchering business and took a load of bullock hides to Menindie, where he got work with his brother George and went with a mob of cattle to Adelaide at 25 shillings per week. He was now 21 years of age and had his first windfall when he inherited £400 from his grandfather in England. With this he started dealing in

horses and sheep as well as cattle, and invested the profits in station properties.

During the 1880 drought he took the risk of investing in £1500 worth of cattle and horses from owners who parted with them for a mere song owing to the scarcity of water. When the drought broke and most of the animals had pulled through, he was a comparatively wealthy man and went on establishing new stations and breeding, and dealing in, horses and cattle. During the 1902 drought he repeated the performance on a much larger scale and bought or leased still more stations. India needed light horses for army remounts, riding hacks and polo ponies. For many years he exported thousands of these annually which he had either bred or purchased. This proved very profitable and he continued to add to his list of properties mainly for cattle-breeding. His central idea was to acquire a chain of stations right across Australia so that pasture and water for his stock should always be available somewhere. His largest holding was Innamincka in the north of South Australia, with an area of 7500 square miles, although it carried only a few beasts to the square mile. Before he died he either owned or leased about 60,000 square miles of country—about twice the size of England—and it was almost literally true that you could travel the 2000 miles or so from north to south in central Australia without being off property in which Kidman had an interest. He was a shareholder and directer of Bovril Estates Limited, whose chief station is Victoria Downs in the Northern Territory, with its subsidiary station Carlton. This is the largest cattle station in Australia, if not in the world, having an area of 12,800 square miles with a carrying capacity of 160,000 cattle. His main scheme rather broke down during the general drought of 1914, but he could personally then withstand the loss of 100,000 cattle and 50,000 sheep. He had the great disappointment, however, of seeing great areas of his properties deteriorating almost beyond recovery through erosion brought about by over-stocking due to a general widespread drought, for which he had no complete answer. At the same time he developed and put to some use an immense area of the arid regions of central Australia and the far north which no one else had the courage and enterprise to tackle.

By the end of the century, through the development of the beef-cattle industry in all the Colonies, but especially in Queensland, the Northern Territory and the north of Western Australia, the number of cattle had increased to the huge total of 8½ million which, however, included over a million dairy cattle.

CHAPTER XI

The Dairying Industry in the Nineteenth Century

THE supply of milk and dairy products was almost as great a problem in the early days as the growth of a sufficiency of grain. The majority of the limited number of cattle imported belonged to the beef breeds which were also suitable for draught purposes. Many cows used for the supply of milk on board ship, however, were left behind in Sydney, and as these had been specially picked for their milking qualities, they formed the nucleus of the first dairy herds.

Pure-bred Ayrshire cattle were imported by a number of settlers, including Atkinson and Howe and, later on, Alexander Berry and John Wyllie of the Illawarra district. The milk and butter supply of the fortunate possessors of such productive dairy cattle and their employees was easily solved, but it is to be feared that the convicts and emancipists generally fared badly with respect to these essential items of diet.

As the population of Sydney and Parramatta grew, the government herds and those of enterprising settlers, like John Blaxland, produced enough surplus milk to satisfy the requirements of those residents who could afford to buy it, although there must have been considerable losses during the hot summer weather. For climatic reasons, too, the quality of the butter made on private properties must have varied greatly. The most successful supplier of butter for sale in the early days was Howe of Glenlee on the Nepean, who greatly improved his pastures by the use of British grasses and clovers. The making of cheese on the farm required greater skill and more elaborate equipment. The pioneer of this branch of the industry was George Rankin of Killoshiel in the Bathurst district, who brought with him the necessary appliances and experience from his native county of Ayr, which was noted even at that time for the quality of the cheese it produced. Milk could only be carted and delivered over a short distance with the primitive methods of transport available, but butter and cheese

could stand the expense of a longer journey, and both were actually sent to Sydney from as far as the Hunter valley and Bathurst districts. In an account of the condition of the Colony in 1828, Governor Darling reported:

> Should butcher meat fall in price the produce of the dairy will probably be more attended to, for which the present prices (three shillings per pound for butter and 1s. 3d. for cheese) hold out ample encouragement. Cheese is made in every part of the Colony, and is of the best quality, being generally preferred to the cheese received from England.

It is difficult to believe that the quality could have been particularly high, although it might quite well have been superior to that which had stood a six-months voyage in a sailing ship without any facilities for the control of temperature.

It was not long after this that the Illawarra district became the chief centre of the dairying industry, a pre-eminence which it held for several decades. This favoured district, which occupies a strip of land of varying width stretching from Wollongong to Nowra and ending in the rich Shoalhaven flats, has a fairly reliable and well-distributed rainfall of about forty inches, and freedom from great extremes of temperature, which makes it particularly adaptable for the growth of pastures and fodder crops. Its main drawback in the early days was the great difficulty of land transport before a proper road over Bulli Pass was constructed. In the fertile valleys and on the hillsides the cedar tree flourished and the first interest in the district was in the exploitation of its timber. By 1819 about 11,000 acres in the Illawarra had been granted for agricultural purposes, chiefly to timber-getters, and the land was at first used mainly for the growth of cereals and vegetables. The climate, however, rendered it very susceptible to diseases like rust in wheat and mildew of pumpkins, and there was therefore a gradual change over to pasture for the grazing of both beef and dairy cattle. The progress of the district was undoubtedly hastened by the arrival of Alexander Berry, an energetic and much-travelled Scotsman. In 1820 he explored the Shoalhaven country, and at first his activities were confined to trading in cedar. He was so impressed with the district that he decided to settle there, combining cattle-raising with cedar-getting, and in 1830 he was fortunate in obtaining a large grant of land at Coolongatta, where, amongst other things, he built up a fine dairy herd. His enterprise and enthusiasm affected others, and gradually the whole Illawarra

district became occupied by settlers who confined their attention mainly to dairying. "The laird of Shoalhaven", as he came to be called, was an important figure in New South Wales, being a foundation member of the agricultural society and a member of the legislative council for a consecutive period of 33 years. By 1834 the Illawarra district was sending kegs of butter to the Sydney market by sea, and the supply must have overtaken the demand, for the prices quoted in Sydney in that year were 1s. 9d. per pound for fresh butter, 10½d. to 1s. 1d. for salt butter and fourpence to sixpence per pound for cheese. Illawarra also gradually became the chief source of milk supply for Sydney, the retail price at that time being two shillings per gallon.

The next area in New South Wales to develop the dairying industry on a large scale was the far south coast from Bateman's Bay to the Victorian border. This district was still more isolated, and confined its activities to the manufacture of butter and cheese, especially the latter. The progress of this area was greatly stimulated by the development of two large dairying estates, Bodalla, founded in the sixties by Thomas S. Mort, and Kameruka by the Tooth family a little later. Both estates were divided into a number of farms, each under the charge of a manager and his family, with up-to-date butter and cheese factories to deal with the whole of the milk, and both acquired a reputation for the quality of their products. In the meantime the growth of population had increased the demand with a marked rise in prices. Indeed, during the gold rush the price of butter went as high as 3s. 6d. to four shillings per pound. It is characteristic of Australian experience, however, that in the early seventies, with greatly increased production, it sometimes fell as low as fourpence per pound.

Advances were taking place simultaneously in all the other Colonies. In Tasmania, with its smaller population, the progress was slow and gradual, just about supplying the local demand. In Victoria, with its phenomenal growth of population, the situation was met by a rapid development of the fresh milk supply in the neighbourhood of Melbourne, and of dairy products on the rich volcanic soils of the western district, whilst the dairying potentialities of the basaltic red loams of the Gippsland district were just beginning to be realized. In South Australia the good rainfall districts to the south-east of Adelaide were proving suitable to the industry, whilst in Queensland the Darling Downs supplied the comparatively small local requirements of the period.

A series of events which took place in the eighties was responsible for spectacular progress in the dairying industry, especially in the manufacture of butter. The first was the opening up of new land in New South Wales, Victoria and Queensland eminently suitable for dairy pastures. Most important of these areas was the big-scrub or rain-forest country in the northern rivers district in New South Wales. Large areas in the vicinity of the Richmond and Tweed rivers carried such an amazing wealth of vegetation as to be almost impenetrable owing to the space between the huge trees being occupied by an undergrowth which included a variety of creepers like the lawyer vine. It seemed hopeless country to clear, and yet it proved comparatively easy and inexpensive, although it involved the loss of much valuable timber. Some carefully selected trees were hewn down with axes, and as they fell they brought down most of the others. The whole levelled scrub was allowed to dry out and then burned off on a dry day with a moderate wind blowing. If a good burn was obtained, the land was pretty thoroughly cleaned up, except for some charred stumps and grass seed sown in the ashes. In a surprisingly short time a very productive dairy pasture was available which gave wonderful results for a few years or even decades. The selectors were mainly sons of farmers from the Illawarra and the far south coast, who were soon doing so much better than their fathers that practically none of the big-scrub country remained long uncleared. A somewhat analogous set of circumstances resulted in the establishment of productive dairy pastures in southern Queensland and the Gippsland district of Victoria.

The second favourable happening of the eighties was one already chronicled, namely the invention of a successful refrigeration system. This not only enabled butter to be preserved for long periods and exported without deterioration, but also allowed the temperature to be controlled during the manufacturing process with great advantage to the quality of the product.

The third was the invention of the cream separator by the Swedish engineer, Laval, and its introduction into Australia by Thomas S. Mort and David Lindsay Dymock. This made it possible to separate the cream immediately after milking on each individual farm and to send it only, instead of the whole milk, to the butter factory, thus greatly reducing the cost of transport and leaving the separated milk on the farm to be fed, with supplements, to calves and pigs. It also greatly increased the efficiency of separation as compared with the older method of

setting and skimming, during which process deterioration frequently set in, especially in the summer months.

The fourth was the introduction of the milk and cream tester invented by Professor Babcock of Wisconsin, U.S.A. This provided an easy and rapid method of determining the percentage of butter-fat and facilitated the payment for the cream on a perfectly fair and equitable basis.

The fifth favourable factor was the introduction of the co-operative principle into the dairying industry, and especially the establishment of co-operative butter factories, which have proved of such immense value to the industry. The first of these was established in 1883 at Kiama in the Illawarra, the leaders in the movement being David Lindsay Dymock and Joseph Weston. It proved an almost immediate success, and it was not very long before similar co-operative factories were erected in all the leading dairying centres in the Commonwealth.

These moves of the early eighties served to put butter-making on its feet as a large-scale industry, and paved the way for a rapid increase in the quantity and improvement in the quality of the butter produced.

As recorded earlier, the majority of the cattle introduced in the early days belonged to the beef breeds, especially Devons and Shorthorns, and they had to form the nucleus of many of the dairy herds. Britain has always been noted for its marked success in evolving and improving a variety of breeds of all classes of farm livestock, including cattle for both beef and dairying purposes, so that it has earned the reputation of being the stud-farm of the world. By degrees the more prominent British dairy breeds—the dairy Shorthorn, the Ayrshire, the Jersey and the Guernsey, and even a few Friesians from Holland—were introduced and used either to form studs of pure-breds or for mating with the cattle already on the dairy farms. The dairy Shorthorn and its crosses became popular in those districts supplying milk to Sydney and Melbourne, especially with suburban dairymen, who usually fattened the cows off after a single lactation period. The Ayrshire gained popularity first in the Illawarra and Hawkesbury-Nepean districts, and later spread to the cooler tablelands, especially where cheese-making was the favourite means of utilizing the milk. The striking increase in the demand for butter production brought the Jersey, and to a less extent the Guernsey, into prominence, especially in Victoria, owing to the high percentage of butter-fat in their milk. These were the most popular pure-breds in the second half of the century, but,

as in the case of beef cattle, the majority of the dairy cattle were the result of either planned or indiscriminate crossing. With a view to improving the milking qualities of the early crosses, into which the beef Shorthorn and the Devon entered too largely, a number of men in the Illawarra district, and especially George Grey of Greyleigh, Kiama, introduced into their herds pure Ayrshire and pure dairy Shorthorn bulls, and selected for future breeding those animals of pronounced dairying quality. Thus towards the end of the century they were gradually evolving a breed akin to the dairy Shorthorn in size and general characteristics, which was afterwards to blossom forth as the first new breed of cattle to be produced in Australia, the Illawarra milking Shorthorn, now the Australian Illawarra Shorthorn.

Of the 8½ million cattle in Australia at the end of the century, 1,200,000 were used for dairying purposes. Besides supplying about four million people with the whole of their fresh milk, and the bulk of their cheese requirements, 112 million lb. of butter were produced and £2 million worth exported, Victoria and New South Wales being much the largest contributors.

The pig-raising industry during last century was almost exclusively associated with dairying, the separated milk, frequently supplemented by home-grown maize and other cereals, providing the basis of their diet. Although a good deal of salt pork had to be imported in the early days, the production in Australia was soon able to overtake and keep pace with the demand, and by the end of the century, the annual production of bacon and ham exceeded 34 million pounds.

CHAPTER XII

Pastoral Progress up to the Time of Federation

EXCEPT for occasional set-backs through dry seasons and falling prices and the ever-present rabbit problem, the pastoral industry continued to progress to the end of the century. The serious commercial crisis which began in 1893, due to the same causes as its predecessor of half a century before, created much hardship to the whole community, but recovery was fairly rapid owing to the inherent soundness of the sheep and cattle industries, especially now that there was a remunerative market for frozen mutton and beef as well as for wool, sheepskins and hides. The improvement of established properties proceeded apace. Comfortable and commodious homesteads were being built all over the country; large amounts were spent on the erection of stock-yards, dips and rabbit-proof fences; the water supply for domestic and stock purposes received greater attention, and up-to-date shearing-sheds became the rule rather than the exception. As the size of individual flocks increased, the annual shearing became a more and more formidable task. Though many shearers acquired great skill with the hand shears and produced some wonderful tallies, the work was very arduous and this directed attention to the possibility of shearing by machinery.

The first successful shearing machine was patented by Frederick York Wolseley, a brother of Garnet, who afterwards became General Lord Wolseley. He arrived in Australia in 1854 and proceeded to Thule on the Murray River, one of the stations owned by his brother-in-law, Mr Caldwell. Here he spent five years learning the art of sheep-farming under the direction of the manager, John Phillips. The latter then bought a property of his own and young Wolseley took over the management of the station himself. It was while he was thus engaged that he seems to have conceived the idea of some kind of mechanical device to lessen the strain and speed up the operation of shearing, and he consequently began experiments with this end in view in 1867. By 1872 he had a working model by which he removed at least part of the fleece from a sheep. Shortly afterwards, however,

he went to England for a period of two years. Soon after his return he rented a room in Melbourne to continue his experiments, in which he received a considerable amount of help from R. P. Park, an engineer. In 1876 he purchased Euroka station near Walgett, New South Wales, partly with a view to trying out his new ideas under practical wool-shed conditions. In the following year he took out his first patent. His original machine, the power for which was derived from an old-fashioned horse-gin, was not a success. In December of the same year he took out a further patent involving the transmission of power by an endless cord running round a series of pulleys, but this arrangement also involved a number of mechanical difficulties. This kind of experience is not unique amongst inventors, and for several years little progress was made. Indeed there is no evidence that a single sheep was completely shorn by any of the earlier devices.

In 1885, however, he engaged as a mechanic a skilled engineer, John Howard, who had arrived two years previously from England, where he had had some experience with a horse-clipping machinery firm. Progress then became much more rapid and mechanical difficulties began to disappear. Although Wolseley must be recognized as the real inventor of the sheep-shearing machine, it seems that Howard was to a large degree responsible for so improving the design that it became a marketable proposition. The first public demonstration of the improved machine had something of the dramatic about it. It took place in Goldsbrough Mort's wool-store in Melbourne, where a regular competition was staged. Starting at the same time, three sheep were shorn by the new machine and three by a very expert shearer, Dave Brown, using the hand shears or blades. The hand shearer won by a narrow margin and this at first appeared to be a definite set-back to the machine. Someone, however, who evidently observed that the machine-shorn sheep appeared to be more closely cropped, suggested that the machine shears might be tried on the hand-shorn sheep. The result was that an additional three-quarters of a pound of wool per sheep was taken off. It is easy to imagine some of the graziers present making a rapid calculation as to the increased revenue from their huge flocks that extra three-quarters of a pound per sheep would mean.

In spite of that Wolseley had difficulty in raising sufficient capital to manufacture the machines on the scale he desired. Further public demonstrations were held in 1887 in a wool-shed in Sydney and at the Queensland jubilee exhibition in

Brisbane, and both got favourable notices in the press. In the same year some notable improvements were made in the mechanical construction of the hand-pieces as the result of ideas supplied by William Ryley. It is interesting to note that most parts of the new machine were manufactured by Park and Company and that one of the engineers responsible was Herbert Austin, afterwards Lord Austin of motor-car fame.

It was all very well to give successful demonstrations with a few sheep in a store or at a show, but it was realized that the new device would have to be tried out in a large shearing-shed over a whole season before the wary pastoralist would be induced to instal it. A preliminary trial in a shearing-shed at Normanby station, Queensland was only a partial success when six boards were occupied by the machines and an equal number by expert hand shearers, with the race for numbers shorn in a given time still slightly in favour of the latter.

In the following year, 1888, a much more ambitious trial was carried out on the famous Dunlop station west of Bourke, owned at that time by Sir Samuel McCaughey and managed by James Wilson. This was one of the largest stations in New South Wales, carrying a flock of about 184,000 sheep, and this trial again had an element of drama about it. Before the forty shearers arrived, the machines were duly installed and placed in position in the commodious shearing-shed. When informed of the position, however, the shearers refused to sign the contract as they wanted nothing to do with this new-fangled machinery. They retired to a camp some distance away, and it took Howard and his associates nearly three weeks of almost daily demonstrations of the advantages of the machine before they reluctantly agreed to make a start. At first their performance was very poor—an average of about 43 sheep per stand per day, partly because of unfamiliarity with the machine methods and partly because the majority of the shearers did not wish to make a success of it. The rate of remuneration was a pound per hundred and gradually some of the keener and more expert men got up to the rate of a hundred a day, which was not bad going. The others by degrees became really interested and began to study closely the technique of the most successful, with the result that the average for all hands gradually mounted to 120 per day. The shearing was completed in a little over two months, and Dunlop's was the first large flock in any part of the world to be entirely shorn by machinery. More important still, a large proportion of the 31 shearers who stuck it out to the end became converts to the new

idea. Actually eighteen other sheds were fitted with Wolseley machines in 1888, and many orders were taken for the following year. The battle had been won and before long several other makes of machines came on the market, with the result that before the end of the century it was the exception rather than the rule to find hand shearing in progress on any large station.

By 1901, when the Commonwealth was established, the number of sheep in Australia, still almost entirely pure merinos, had increased to about seventy million. All the Colonies shared in the advance.

In Queensland, following in the tracks of Leichhardt, Kennedy and Mitchell, the pastoral expansion was greatest, as there was a very much larger area of land suitable for beef cattle and sheep still available for occupation than in any of the other Colonies. At the same time she was beginning to realize her resources for the expansion of the dairying industry and for the growth of tropical and semi-tropical crops like sugar, cotton, bananas and pineapples.

The bulk of the occupiable land in New South Wales had already been taken up and a considerable amount of subdivision into smaller holdings had been going on ever since 1861. Although the pastoral industry predominated the efforts of the land-holders in the better rainfall districts were more and more directed towards dairying, and in the medium rainfall districts towards large-scale wheat-growing.

The same was even truer of Victoria, where wheat-growing had developed into quite a considerable industry, and a start had been made with a still more intensive form of land use by the introduction of irrigation farming at Mildura.

In South Australia, McDowall-Stewart's crossing of the continent from south to north following on Eyre's earlier explorations established the facts that about four-fifths of it had too small a rainfall for anything more than sparse pastoral occupation, although the preponderance of summer rainfall in reasonable abundance in what is now the Northern Territory rendered it suitable for the beef-cattle industry. In the development of this whole region, as we have already seen, Sir Sidney Kidman played a prominent part. South Australia, however, became the leading agricultural State in the later decades of last century. Besides cereal-growing, which occupied by far the largest area, she had already developed viticulture and wine-making to quite a considerable extent, and had followed Victoria's example by establishing a small irrigation settlement at Renmark.

Exploration in the huge Colony of Western Australia by John and Alexander Forrest, the Jardine brothers, Baron von Mueller and others had confirmed the large proportion of desert and semi-desert in the interior, but an extensive area of good winter rainfall country in the south-west and summer rainfall cattle country in the north, and these areas gradually became occupied and stocked up. The discovery of gold at Kalgoorlie and Coolgardie in the nineties, followed by O'Connor's and Sir John Forrest's great water-supply scheme, brought capital and population and improved the local demand for agricultural production, which was readily met. The sheep population of the light carrying semi-arid country continued to increase, the wheat-growing possibilities of the more favoured portions of it were just beginning to be realized towards the end of the century, and a new spirit of optimism had entered into the whole community.

In Tasmania a few prominent merino breeders, as we have seen, had raised their stud flocks to such a standard that high prices were paid for the rams which they sent to the sales in Sydney and Melbourne. Nearly all the more accessible land was fully occupied and more and more attention was devoted to mixed farming, dairying and the growth of crops such as potatoes, hops, apples, pears and small fruits suitable to a cool climate.

It is rather characteristic of Australian experience, however, that three happenings of a less favourable character occurred to dim an otherwise pleasing picture. From the very earliest days, droughts and dry spells had frequently hampered progress, but their effects were somewhat mitigated by the fact that most holdings were not fully stocked. Although the culmination of the most disastrous drought in Australia's history did not take place till 1902, the last four years of the century were much drier than normal, and as individual properties as well as the occupied country as a whole were then stocked up to their full capacity in normal seasons, there were many deaths amongst the flocks and herds from lack of food or water or both.

The second adverse circumstance was the occurrence for the first time in the nineties of the loathsome blow-fly or sheep-maggot fly pest. There are numerous references in the literature to the damage caused to foodstuffs by blow-flies from the very earliest days in Australia, and flock-owners were pleased, and at the same time puzzled by their failure to attack the live sheep as they did in Britain and on the continent, especially as the climatic conditions appeared to be favourable for such an attack for a

much longer period each year in Australia. In the early nineties, however, the sad news went round that live sheep had been attacked, although it was not till 1903 that the pest became really serious, the dry years having helped to keep it in check. Wet and stained wool attracts the flies, on which they lay their eggs or the actual young maggots, which develop with amazing rapidity, burrow through the wool to start devouring the skin and flesh, causing great suffering, and, if not attended to, the death of the sheep. Recent research has given the probable explanation of the mystery of the long delay in the occurrence of the pest on the live sheep. There are quite a number of different species of blow-flies, but only one of them—the primary fly (*Lucilia cuprina*)—has the habit of infecting the live animal. After it has started the trouble several other species can carry on the hateful work. The delay was therefore probably caused by the absence of the primary blow-fly until about the time when the trouble began. Ever since 1903 pastoralists have carried on a sustained campaign by means of dipping, jetting and swabbing to kill the maggots, and by crutching and trapping, an operation (the Mules operation) to remove the wrinkles from the neighbourhood of the crutch to lessen the incidence of the strike. Nevertheless, the losses through deaths, deterioration of wool and expense of preventive and remedial measures have cost the industry millions every year, and most graziers would agree that the blow-fly is comparable with the rabbit pest as a limiting factor in the development of the sheep and wool industry. Fortunately there is reason for hope that some of the new insecticides applied by dipping, jetting or swabbing, with crutching and a modified Mules operation, will gradually lessen the incidence of this serious and obnoxious pest.

The third unfortunate occurrence affected the cattle industry, namely, the introduction and spread of the cattle-tick, with its accompanying tick fever. Attention was first attracted to the trouble by the heavy mortality in a mob of cattle about 1880 at Glencoe, which is situated about 100 miles south-east of Darwin in the Northern Territory. From this centre it spread slowly in all directions, reaching the MacArthur River in 1890 and Longreach and Hughenden by about 1895. Nothing definite was known about the nature of the malady till C. J. Pound was deputed by the Queensland government to carry out an investigation in 1894. His report published in the following year was to the effect that the fever was carried by a protozoan parasite attacking the red blood corpuscles of the affected cattle, gaining

entrance to the blood stream and transmissible from one animal to another by the medium of the blood-sucking cattle-tick. It was thus found to be identical with, or closely analogous to, well-known diseases occurring in Europe, Asia, North and South America and South Africa, and known by such names as Texas fever and red-water fever. A heavy infestation of ticks, even in the absence of the protozoan parasite, may prevent cattle from thriving and even cause death through irritation, worry and loss of blood. There is a slowing-up in breeding; the production of meat and milk is reduced and there is a very considerable deterioration in the value of hides. Systematic dipping reduces these losses to a minimum. By far the greatest damage, however, is done through the transmission of tick fever, which invariably causes a large percentage of deaths.

When the tick reached the railheads in Queensland and was transferred by train to Townsville and Rockhampton, the advance was greatly speeded up. In the coastal districts it found a still more congenial habitat, and it rapidly spread as far as Brisbane in 1899. An attempt, costing many thousands of pounds per annum, has been made to stop its advance at the New South Wales border, but in spite of every effort there have been several inroads of the tick into New South Wales, the latest as far south as Coff's Harbour.

As already pointed out, none of these three major enemies of the pastoralist had reached its maximum when the federation of the various States took place in 1901, but they proved serious drawbacks to the rapid progress of the new Commonwealth of Australia which came into being in that year.

CHAPTER XIII

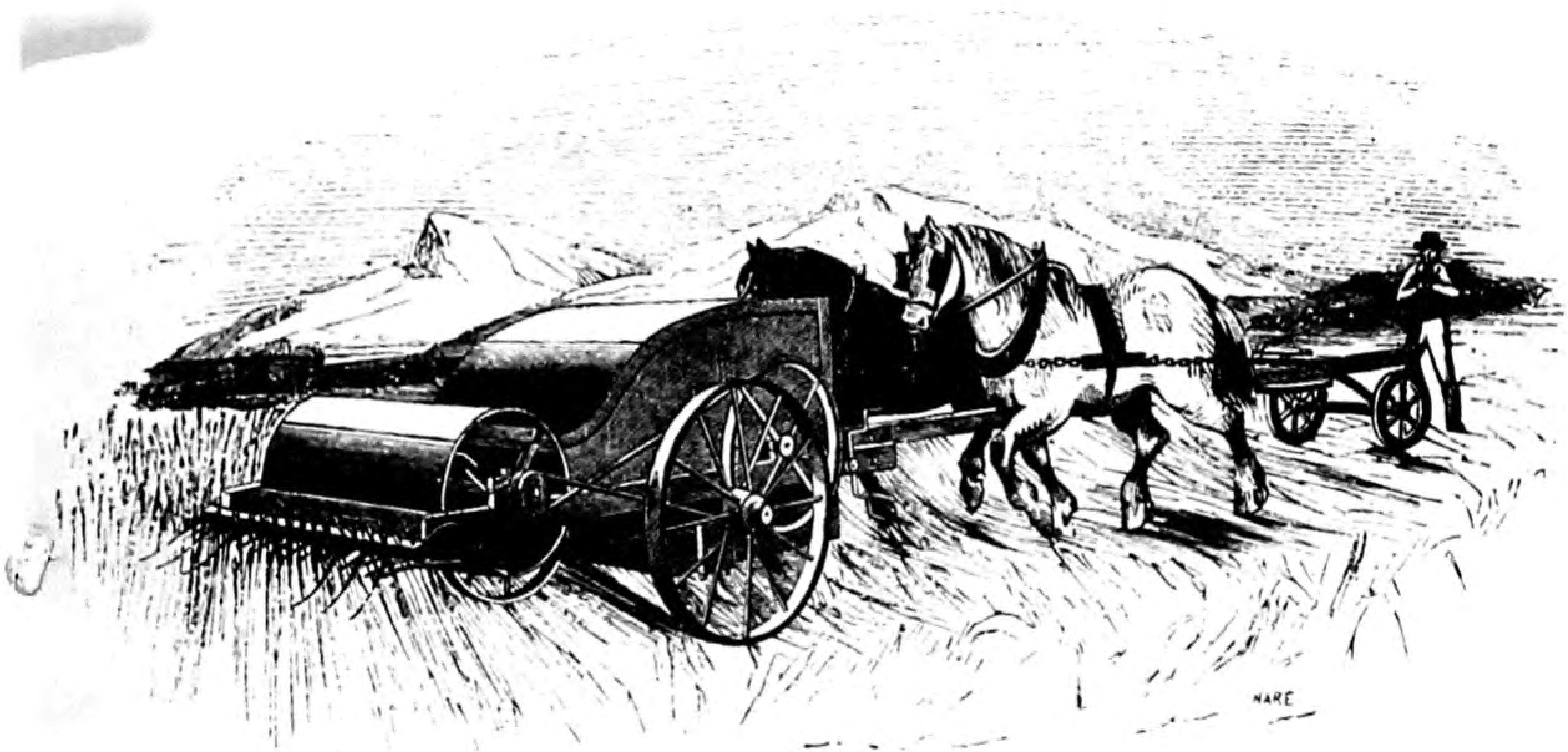
Early Agriculture

HAVING traced some of the main highlights of the pastoral and dairying industries up to the end of the nineteenth century, it is now necessary to have a closer look at the more distinctly agricultural activities for the same period. The first fleet arrived in a corner of a huge continent inhabited by one of the most primitive races in the world, which depended for its food supply on a native flora singularly devoid of edible plants, and on a fauna which made little appeal to the appetites of white people. The aborigines had not reached the stage of engaging in any kind of agricultural pursuits, so that nothing could be learned from them, and the first white settlers started in almost complete ignorance of the soil and climatic conditions of the continent.

It was quite easy for the British government to include in Governor Phillip's instructions, "It is our will that you do immediately proceed to the cultivation of the soil." It was not quite so easy for Phillip and his mixed company of a thousand or so to put it into practice, especially with the primitive implements which were supplied to them. Soon after landing, Phillip reported that "the axes, spades and shovels were the worst that ever were seen", and it was evidently necessary to use some of the implements intended for other purposes for agriculture, for we find Phillip further stating, "Two or three hundred frying-pans will be a saving of spades."

It was the original intention that the convicts should carry out the various agricultural operations under government supervision and that, as their terms of imprisonment expired, they should be granted small areas to farm on their own account. It appears, however, that only one of the government supervisors, (H. E. Dodd) and only one of the convicts (James Ruse) had had any previous agricultural experience. Moreover, most of the land in the vicinity of Sydney and Parramatta was covered with a fairly dense forest. Of the two chief classes of soil, that on the Hawkesbury sandstone was shallow and poor, and even the Wianamatta shale soils were not very fertile and rather difficult

AN EARLY SHEARING-SHED EQUIPPED WITH MECHANICAL SHEARING MACHINERY



RIDLEY'S ORIGINAL STRIPPER

to cultivate owing to their clayey consistency. It is hardly to be wondered at, therefore, that the agricultural efforts of the first few years produced little more than seed for the following year's sowing. Later instructions as already recorded gave Phillip power to offer larger areas of land as free grants to civil, military and naval officers, several of whom, like John Macarthur, showed much more energy, intelligence and skill in the development of their properties. Some assisted immigrants with agricultural experience but little capital and a few other adventurous settlers, possessing both agricultural knowledge and a considerable amount of capital, began to arrive, and thus self-sufficiency in the food supply, except in adverse seasons, was gradually attained.

After the first four or five years, besides the operations carried out by the government, there were thus five different classes of people engaged in agricultural pursuits—ex-convicts, service officers, civilian officers, assisted immigrants and free settlers with capital.

The area allotted to ex-convicts was thirty acres for single men and fifty acres for married men, and their first blocks were situated in the neighbourhood of Parramatta, radiating in a northerly, westerly and southerly direction. Here the picture is similar to that described in the case of James Ruse. The trees were slowly and laboriously hewn down by axes and burnt on the ground when sufficiently dry, leaving stumps about two feet high. In between the stumps the soil was dug or hoed over with great difficulty owing to the presence of tree-roots and the hardness of the ground except when it had about the correct moisture content. In April or May the wheat was sown by hand and covered over by using the hoe again. Nothing further was done till harvest time about December, when the grain was cut with the sickle and bound into sheaves by hand. When dry the sheaves were frequently carried on men's backs and stacked near a primitive barn, where the grain was laboriously beaten out by flails, the chaff and lighter weed seeds being separated by the action of the wind as the mixture of grain and chaff was slowly shovelled over. It was then transferred to bags ready for market. About ten acres was as much as a man could handle with the help of his family or additional convict labour at the busy times. While the crop was growing the ex-convict farmer might hire himself out to one of the more opulent settlers or engage in the preparation of further land, planting it with maize in September or October. He might also have a small area growing potatoes and other vegetables. Usually he had no livestock on his farm except poultry and sometimes a few pigs. He retained

enough wheat for his own use and enough maize to supplement the rations of his pigs and poultry, although, if the wheat harvest proved disappointing, part of the maize grain might have to be used for human consumption as well. Theoretically the only possible market for his grain was the government store, but it became increasingly common for traders and service officers to come round and offer him tea, tobacco and rum at exorbitant prices in exchange. Crops were indeed frequently mortgaged in advance to these avaricious dealers.

Continuous cereal cropping, together with the practice of burning the straw and cornstalks, soon reduced the fertility of the soil and the crops yielded less and less grain and became overrun with weeds, especially darnel or drake (*Lolium temulentum*). Altogether it was an almost hopeless battle and many deserted their farms or left them in the hands of their creditors and sought employment elsewhere. When the alluvial soils on the banks of the Hawkesbury were discovered, Richmond and Windsor became the chief agricultural centres. Greater success rewarded their efforts there owing to the more abundant crops from the richer soils, whose fertility was refreshed by repeated floods. The latter, however, caused destruction of crops and livestock at frequent intervals. Even in this more favoured locality the majority failed to gain a decent livelihood, especially those who took intoxicating liquors in exchange for their farm produce.

Of the military officers who took up land, John Macarthur, as we have seen, was the most successful, and his methods were gradually copied by other officers, both service and civilian. With a much larger area, which seemed to go on increasing either by purchase or additional grants, he was in an entirely different position from the emancipist settlers. With the aid of quite a large number of convicts, whom he partly supported, and some ex-convict employees he was able to clear the land thoroughly of all stumps and surface roots so that ploughs and harrows could be successfully employed. His area was also sufficient to allow him to keep increasing numbers of sheep, cattle and horses as well as pigs and poultry, the surplus animals bringing in much more revenue than his grain crops. Indeed, even before the merino was introduced, it was the breeder of livestock who got much the greatest financial return from his enterprise.

In his influence on early agricultural and pastoral development, second in importance to Macarthur amongst the military officers who took up land, was Captain William Cox. In January

1800 he arrived in Sydney as paymaster to the New South Wales Corps after considerable land experience in his native county of Wiltshire. Soon after his arrival he purchased Brush Farm near Ryde and also the holding which Rev. Richard Johnson had vacated at Canterbury, and immediately became actively engaged in agriculture. Both properties were going concerns, but it is rather surprising to learn that in the following year (1801) he had 400 acres cleared and 245 acres in wheat and maize. When prices fell so disastrously in 1804 he had to part with Brush Farm and thereafter devoted himself mainly to pastoral pursuits at Clarendon near Richmond. He retired from the army during the Bligh rebellion, in which he took no part. It was from Clarendon that Governor Macquarie and his party left on their famous expedition to Bathurst after Cox had performed the wonderful feat of constructing the first rough road over the Blue Mountains. For the latter service he was given a grant of land on the Bathurst plains which he named Hereford. Several members of his family explored and settled in the Mudgee district, where they soon became keen rivals of the Macarthurs in improving the merino breed of sheep.

Amongst the civil officers who obtained free grants of land, the Rev. Samuel Marsden of Parramatta was much the most successful. He was born at Farsley in Yorkshire, where his father had a small farm, and this accounts for his interest and success in agricultural pursuits. After leaving school he worked for some years as a blacksmith which helped to build up a strong constitution. Later on he was trained for the Anglican ministry. Before completing his theological course at Cambridge, however, he accepted the position of assistant-chaplain in New South Wales and arrived in Sydney in 1794, six years after the foundation of the Colony. He was immediately sent to Parramatta which became the centre of his activities for over forty years. He showed great energy, enthusiasm and zeal in all his undertakings and had an abundance of physical vigour and powers of endurance. It was fortunate that he possessed these qualities, for he had a very busy life in an age and place where hardships were all too common. In 1800 the senior chaplain, Rev. Richard Johnson, found it necessary to resign his position owing to the strenuous nature of the work and the lack of proper amenities undermining his health. Marsden was thus left single-handed to attend to the spiritual requirements of a distinctly unruly community scattered over a wide area. Soon after his arrival he obtained from Lieutenant-Governor Grose the usual grant of

100 acres with a number of convicts as servants, "victualled and clothed from His Majesty's stores", to assist in bringing the land under cultivation. It may safely be said that Marsden took up farming in the first place as a duty to help with the food supply and as an example to others, for he stated, "It is not from inclination that my colleague and I took the axe, spade and the hoe. . . . It has ever been the opinion of those who have the best means of information that, if General Grose had not adopted this wise, humane and effective measure or, if his officers had not seconded his liberal views with the best exertions, the inhabitants must have perished from want." As reliable men for such a position were scarce he was also obliged, much against his will, to perform the duties of magistrate. Writing in December 1798, he said, "I have much to occupy my time and a great variety of duties to perform. I am a gardener, a farmer, a magistrate and a minister. Yesterday I was busy in the field getting in my wheat. To-day I have been sitting in the Civil Court hearing the complaints of the people. To-morrow, if well, I must ascend the pulpit and preach to my people." Martin says of him, "The work Marsden managed to get through as a clergyman, a magistrate and pioneer colonist is simply stupendous." In spite of these exacting duties, he made no less than seven missionary voyages to New Zealand, where he soon gained the respect of the Maoris by his courage and friendliness.

Marsden's original grant of 100 acres was in the neighbourhood of Dundas, where, with the aid of his convict servants, he proceeded energetically with the clearing of the land and the growth of crops. By 1804 he had 120 acres in wheat, forty acres in maize, 25 acres in barley, seven acres in fruit trees and two acres in peas and beans—a very fine effort indeed! It was not long, however, before he realized, like Macarthur, that the returns from livestock were likely to be much more remunerative than from the primitive methods of agriculture then employed. From 1796 (two years after his arrival) he began to purchase a few sheep from ships which arrived from India or the Cape. These were purely mutton sheep with an almost valueless covering of hair rather than wool. They were, however, early maturing and prolific, so that he soon made quite a considerable contribution to the much needed supply of fresh animal food. In 1798 he obtained one ram and one ewe from the small consignment of merino sheep which Waterhouse and Kent had brought back from Table Bay. With his expanding flock he required more land and he received two more grants from Governor Hunter, so that

by 1802 he had 440 acres, of which 200 acres were already cleared, and his livestock included seven horses, 21 cattle and 480 sheep. Two years later his area had increased to 1720 acres and his sheep to 1210, and two years later still (1806) to 2908 acres and 1416 sheep. The final grant of 1030 acres was at Mamre near St Marys, where he conducted his main sheep-breeding activities.

In 1807 he paid a visit to England, taking some of his best wool with him. In the vicinity of his native village he had it woven into cloth and had a suit made from it. He wore this suit during a visit to King George III, who admired it so much that he insisted on having a suit made of the same cloth for himself.

Marsden was able to oblige him and out of gratitude, the king presented him with five merino sheep from his own flock, which Marsden brought back with him to Australia in 1810. Some people, therefore, contend that Marsden should share with Macarthur the honour of being the founder of the fine-wool industry in Australia. Although Marsden did a very great service to the young Colony by the vigour and efficiency which he put into agricultural and pastoral pursuits when the products of these industries were so urgently required, there is no evidence that he established a flock of pure merinos. Although he realized quite clearly the advantages of the merino from the point of view of wool quality, he always had as his main objective the production of mutton and consequently used his merino rams for crossing only. This is made quite clear from the following passage from a memorandum he presented to Governor King in 1805:

> I have not always chosen a ram of the finest fleece to breed from. Anyone that has appeared deficient in weight and constitution has generally been neglected, though his fleece might be of superior quality. One true-bred Spanish ram and ewe with four half-bred South Down rams have been the sheep that improved my flock very far beyond my expectations both in beauty, constitution, weight and fleece. So far I have always considered the pure Spanish breed much more delicate in their constitution and lighter in carcase than the produce of ewes crossed with the Spanish or half-bred South Down.

Samuel Marsden was probably second only to Macarthur in the success which attended his devotion to agricultural and pastoral pursuits in the early years of the Colony. Some of his contemporaries were evidently of the opinion that he devoted too much of his time to farming to the neglect of his clerical duties.

The most prominent of these critics was Governor Macquarie himself, with whom Marsden was frequently in conflict. Macquarie wrote on one occasion, "His days were divided between the cares of farming, grazing and trade." Indeed, the disputes between these two strong-willed men were mainly responsible for the appointment of J. T. Bigge to inquire into the state of the Colony towards the end of Macquarie's administration.

By April 1804 the general situation was that 37 men (chiefly officers) occupied about 17,000 acres, averaging 460 acres each, and 550 settlers (chiefly ex-convicts) held 23,000 acres of an average size of 42 acres.

CHAPTER XIV

The First Free Immigrants

It will be remembered that Phillip was keen to get a number of farmers with their families as free settlers to help with the production of food and other necessaries of the young Colony. The first of these did not reach Sydney till a short time after Phillip's departure, for we learn that "on the 15th of January 1793 the *Bellona* arrived having on board, besides a supply of stores and a few female convicts, five settlers and their families, a master millwright and a master blacksmith".

There was quite a considerable area of land between Sydney and Parramatta where the soil was reasonably suitable for agriculture and it might have been preferred to that near Parramatta for the first government projects as well as the settlement of the ex-convicts but for the absence of fresh water. As it was so convenient and was comparatively level, it was ear-marked for occupation and some of the military and civil officers chose their blocks there. Portion of this was also chosen for the new assisted immigrants, and Captain Collins writes, "Early in February the settlers who came out in the *Bellona* took possession of their grounds. Being all free people (one convict excepted, who was allowed to settle with them) they gave the appellation of Liberty Plains to the district in which their farms were situated." This area is now occupied by Strathfield and adjacent suburbs.

The main conditions under which they agreed to settle were "to have their passages paid by the Government; an assortment of tools and implements to be furnished them from the public stores; to be supplied with two years' provisions; their lands to be granted free of expense; the service of convicts to be assigned to them and these likewise to have two years' provisions and two years' clothing". These may appear liberal terms, but it required some such inducement to cause English farmers to forsake their regular way of life for the uncertainties of the distant penal Colony. Unfortunately these first assisted immigrants, from whom so much was expected, turned out to be of an inferior type and there is little evidence to show that they were successful in their

venture or that they made, as a group, any valuable contribution to the needs of the Colony. Indeed, Governor King in a dispatch to the home government eight years later states:

> Settlers are of two classes—those who came free from England and those whose terms of transportation were expired or who are emancipated. Of the first I am sorry to say that their industry and exertions by no means answer the professions they made in England, several of whom were so useless to themselves and everyone about them that they were not only a burden to the public but a very bad example to the industrious. As they brought no other property than their large families, many have been, and will continue to be, an expensive burden to the public, or starve. This description of settlers are maintained for eighteen months and have the labour of two convicts assigned to each, which is very sufficient to provide against the time of doing for themselves, but that period too often discovers their idleness and incapacity to raise the least article from a fertile and favourable climate after having occasioned an expense of upwards of £250 for each family, exclusive of their passage out.

Those free immigrants who brought a considerable amount of capital with them were very few in numbers in the early days, but they were in quite a different category, as they included a number of men who made important contributions to the production and general well-being of the community. Amongst them were two notable brothers—John and Gregory Blaxland—who agreed to settle in New South Wales and bring each a capital of £6000 on the condition of passages for themselves and their families, with a grant of 8000 acres of land with one convict for every hundred acres to clear and cultivate it, "to be clothed and victualled for eighteen months according to the custom of the Colony".

The Blaxlands came of a well-known family of Kentish landed proprietors, and it is rather surprising that men and women of refinement, education and social standing in their own community should have embarked on such a dangerous and problematical adventure. They were undoubtedly influenced by Sir Joseph Banks, who was constant in his efforts to induce skilled farmers and stock-breeders to settle in New South Wales.

The name of Gregory Blaxland has become a household word throughout Australia as the leader of the first successful expedition to cross the Blue Mountains, but his elder brother was probably the more capable of the two and he also made a very

substantial contribution to the progress of the young Colony.

It was agreed that Gregory should come out first, and he arrived in Sydney in April 1806 after a perilous voyage of 32 weeks' duration. Besides his wife and family, he brought with him quite a collection of sheep, cattle, bees, plants and agricultural implements, including a plough, which was rather a rarity in the Colony at the time. It was towards the end of King's administration, and he had the greatest difficulty in getting any semblance of the promised concessions—land and convict labourers—as King regarded him as rather an intruder in his prison camp.

In August of the same year Bligh arrived as governor and he proved still more difficult, and so Gregory just marked time till his older and more experienced brother arrived.

In spite of these set-backs, Gregory evidently formed a rather exaggerated impression of the country, for in a letter written in October 1807 he said, "I have a very good opinion of the natural fertility of the soil and consider the Colony able to support more inhabitants to the square mile than any country I have before seen. The climate is so mild that some form of food is growing all the year round."

John reached Sydney in the following April in a vessel chartered by himself loaded up with a large quantity of goods for sale, as he hoped to engage in trading as well as farming. He, too, was accompanied by his wife and family and a few domestic servants and agricultural labourers, and brought with him instructions to Bligh from the home government to give him further concessions in lieu of the free passage he had not received. Bligh, however, placed every possible obstacle in his way. One condition, for instance, was that he was to get sixty cattle from the government herds, to be paid back in the form of "produce". Blaxland took that to mean any kind of farm produce, but Bligh insisted that he should hand back to the government twenty young cows every second year, and this forced him to concentrate mainly on cattle-breeding.

The only land he could get from Bligh was 1290 acres on the south side of the Parramatta River, which included a good deal of swamp land. He also acquired by purchase a small block near the present Sydney town hall, which was then on the outskirts of the town. In spite of the inferior nature of most of the soil on the Parramatta River property, he developed both the dairying and beef-cattle industries as well as vegetable-growing by intelligent and progressive methods. and was soon selling meat,

dairy produce and vegetables to the inhabitants of Sydney of higher quality and at lower prices than previously.

It is quite understandable that he approved of the actions of Johnston and Macarthur in the deposition of Bligh, but he was disappointed that when they took command they showed no inclination to grant the concessions he had been promised by the home government. He therefore left Gregory in charge of his affairs and sailed for London in September 1808 in order to seek redress. Bligh, however, sent a letter to the governor at the Cape by the same vessel accusing him of being a party to his deposition and he was arrested and put in jail. He was later shipped to England, where he was liberated, but had to remain for three years as a witness in connection with the trial of Colonel Johnston. He returned in triumph in 1812 with a letter to Macquarie ordering that the original agreement should be carried out in full. Even he was slow to act, because at that time the Colony was suffering from a serious shortage of grain and had to import wheat in considerable quantity from India and he severely criticized the Blaxlands for devoting their energies to what he considered the lazy occupation of cattle-breeding instead of that of cereal-growing. This was rather hard after Bligh's bargain about cattle, and in view of the fact that very little of the land yet granted to the Blaxlands was suitable for wheat-growing. Macquarie, however, granted John 671 acres on the Nepean River in 1813, which he named Luddenham, after the family estate in England. He really ought to have been very grateful to the Blaxlands, for the great increase in the number of cattle during his administration was due in a large measure to them as was also the fall in the price of meat in Sydney from 2s. 6d. per lb. in 1807 to sevenpence per lb. in 1813.

The Blaxland brothers, indeed, were amongst the most prominent and successful cattle-breeders of the early days. Their activities were by no means confined to cattle-breeding, as John particularly engaged in quite a number of enterprises. His general agricultural activities were probably as advanced as those of any other settler of the period. In 1812 he imported two improved ploughs which were said to be capable of doing twice the work of the older types. On his Parramatta River property, which he called Newington, he grew quite a variety of fruit and vegetable crops, and experimented with the cultivation of flax and hemp. The supply of salt in the early days was frequently inadequate and lacking in quality. He obtained technical assistance and established salt-works, with the result that by 1817

Sydney was receiving a fine quality product at the rate of eight tons per week at a price of five pounds per ton. Some of the cattle from his other properties were sent to Newington to be slaughtered and converted into corned beef for sale to the masters of ships which called in at Sydney. He also erected a bone-crushing mill and established lime-works, and at one time had 300 employees in his various enterprises. He took a prominent part in the agricultural society and was a member of the legislative council from 1829 almost up to the time of his death in 1845.

Gregory's first property was at South Creek, near the foothills of the Blue Mountains, which seemed to him to hold out a perpetual challenge. Some preliminary excursions seemed to indicate to him that the best policy for crossing the range would be to keep to the tops of the ridges, with the successful result which has already been recorded.

Gregory afterwards purchased Brush Farm, on the north bank of the Parramatta River near Ryde from William Cox and this became his main place of residence. Here he experimented with various grasses and fodder crops and was the actual pioneer of the use of oats as a hay crop. Perhaps his greatest contribution to the purely agricultural development of the infant Colony was his pioneering work in connection with viticulture and wine-making.

In 1819 he imported a number of vine stocks from Cape Colony and gradually found the varieties best suited to local conditions and most resistant to the blights which had acted as a serious deterrent to the industry. Four years later he sent a small quantity of a claret type of wine to England and it was awarded the silver medal of the Royal Society of Arts. This was actually the first export of wine from Australia.

In 1827 he was deputed to take to England a petition by the inhabitants of the Colony asking for trial by jury and taxation by representation. He took with him a larger quantity of wine of his own making, and this time received a still higher honour—the gold Ceres medal—by the same society. Although the wine was only of one type and the quantity was not very great, he is regarded by some as the real founder of the wine industry in Australia.

The Blaxlands, indeed, deserve a more prominent place than they usually get in our agricultural history, especially as they were "the first non-official settlers, the first to choose New South Wales purely as a source of farming operations and a home for their families".

CHAPTER XV

Crops Grown in Early Days

It was only natural that the greatest attention should be paid by the early settlers to wheat and maize as the mainstay of the human and livestock populations. They were, however, by no means the only crops cultivated. Other cereals like barley and oats were grown to a limited extent and were partly used as green fodder crops for horses, dairy cattle and pigs and the oats also for hay. Vegetables were grown in most gardens for home consumption and in increasing amount for sale, especially potatoes and cabbages. Turnips, carrots, onions and marrows were included in the list, and it is interesting to note that pumpkins soon became popular, although practically unknown in Britain at the time. Apples, pears, quinces, figs, grapes, strawberries, oranges and lemons are definitely known to have been introduced by the first fleet. Seeds or plants of others must have arrived soon after, either on government account or introduced by settlers, as we soon hear of the successful cultivation of peaches, apricots, nectarines, plums, cherries, loquats, passion fruit and watermelons. Gooseberries, currants and raspberries did not do so well in the neighbourhood of Sydney, but were grown with great success in the cooler climate of Tasmania.

Especially before wool became plentiful, it was the desire of the home government that fibre plants should be grown as a source of clothing for the convicts. Chiefly for that reason, a small expedition was early dispatched to start a settlement on Norfolk Island, where the New Zealand flax plant (*Phormium tenax*) was known to be growing naturally. The leaves of this plant contain a higher percentage of fibre than any other, but the fibre is coarse and more suitable for the making of rope and twine than for clothing. Little progress was made owing to insufficient knowledge and the lack of the proper machinery for the separation of the fibre and its preparation for weaving. It was known that the Maoris were expert in the treating of this crop and so a boat was sent to New Zealand which returned with two Maoris, who were practically kidnapped. The expedition made

the mistake of bringing back men, as they had to confess tnat they knew very little about the business, which they generally left to their womenfolk at home. Some progress, however, took place, and a considerable amount of coarse cloth was manufactured. The plant was introduced into New South Wales and grown on a small scale, but there is no evidence that it was utilized commercially there. European flax and hemp met with more success, especially the former, and it was manufactured into linen cloth in a little factory at Parramatta. Attempts were also made to grow cotton, but the climate was not quite warm enough for its proper maturity. Sugar-cane growing was attempted, with similar results. Tobacco was grown with some success, although no adequate facilities for curing and manufacturing it existed until an American started a small factory on the Hunter River.

Drunkenness was one of the prevailing evils in the early days, and successive governors made earnest endeavours to check it. Attempts were made to produce milder substitutes for the Jamaica rum and home-distilled spirits which caused the trouble. Hops were at first imported and later grown with success by James Squires on his property between Ryde and Gladesville, and several breweries were established. Some vine cuttings had arrived from South Africa with the first fleet, but by 1800 only about two acres were producing grapes, and wine-making experiments had not been very successful. In that year two Frenchmen were brought out with a view to remedying this position, and 7000 cuttings were planted out at Castle Hill, near Parramatta. In 1804 Governor King had to report that the experiment was a failure owing to the occurrence of at least two diseases of the vine, the worst being anthracnose. In his report to the secretary of State for the Colonies he thus describes it: "This is the third year that they (the vines) have been generally blighted. The Frenchmen who came out in 1800 to manage this object knew very little about their business. They attempted last year to make wine from some of the best grapes that could be collected but it has turned out so bad that I shall not trouble your Lordship with the sample I intended sending." The industry was consequently practically abandoned for a time, until Gregory Blaxland and the Macarthurs surmounted the early difficulties.

In addition to oats and barley as fodder crops, rape and turnips were grown as field crops by a few of the progressive land-holders. Nearly all the best-known English grasses and clovers were tried out to improve the native pastures, some being cut for hay which brought good prices in Sydney. The most successful were rye-

grass, meadow fescue and white clover. The most useful introduction of this kind, however, was lucerne, which on the Hawkesbury and Nepean flats yielded several good crops of hay in a year.

Many of these crops, or varieties of them, were imported by private settlers and some by the government, but when the botanic gardens were established on the site of the original farm fronting Farm Cove in 1816, under the direction of Charles Frazer, the first government botanist, this service was placed on a much sounder basis.

Not all the varieties introduced were suitable to their new habitat. The first variety of wheat to which we find reference was Cape wheat. It might have been expected to do better than English varieties, but in 1795 it was stated to have failed and to be "not worth the labour of sowing". For several decades the most popular varieties were red Lammas and creeping wheat. White Lammas and a compact-headed variety called Dumpty were also grown, besides a variety called Macquarie wheat. From the description, the latter was a Durum or macaroni variety, not very suitable for bread-making although relatively resistant to drought and rust. Red and white Lammas are well known British varieties which have survived in England almost to the present day, and they must have been too late in maturing to be ideal for Australian conditions. Creeping wheat, from all accounts, was still later in maturing and consequently still less suitable. According to Atkinson, however, none of the varieties were kept pure and much grain was lost at harvest time by many heads in a field being dead ripe before the general bulk of the crop. There is not sufficient data to enable us to identify the varieties of maize grown, but both Cape and skinless barley, which were favourites from the start, are still grown to some extent for green fodder.

Besides the disabilities to which reference has already been made, the outstanding difficulties which confronted our earliest farmers were similar to those of the twentieth century, namely, the vagaries of the seasons and fluctuating prices. Poor crops, due to droughts and floods, with consequent high prices, alternated with seasons of abundance and low prices. An investigation carried out in the Hawkesbury district in 1800 estimated the cost of production of an acre of wheat to be £13 5s. 9d. Even with a crop of 25 bushels, that showed a loss of 15s. 9d. per acre at the ruling price of ten shillings per bushel. In 1814 a committee of magistrates declared, "It is the unanimous opinion of

the meeting that wheat and maize cannot in general be grown in the Colony . . . at a less selling price than ten and five shillings per bushel respectively."

The first serious drought in the Colony occurred in 1798-9. In January 1799 it was stated that "the wheat was little better than chaff and that the maize was burned into the ground". On 1st May of the same year Governor Hunter reported to the Duke of Portland that "there had been no rain for ten months; the whole country was in a blaze of fire; pasturages for the time being destroyed and streams of fresh water had dried up". The drought broke in June, followed by a bumper harvest, and the wheat crops at the main agricultural region, the Hawkesbury, continued to be satisfactory for the next six years. In some years, indeed, the supply exceeded the demand, and in 1804 the price of wheat fell as low as 3s. 6d. per bushel. Then in March 1806 the settlers, whose farms extended for thirty miles on both sides of the Hawkesbury River, encountered their first disastrous flood. Livestock, buildings and produce of every kind were swept away, leaving the majority of the settlers to poverty and starvation. Wheat went up in price to four pounds per bushel and a two-pound loaf of bread cost 4s. 6d. to five shillings, and even maize meal sold at 2s. 6d. per lb. Amongst the casualties were the majority of the pigs of the Colony, and the total damage was estimated at £35,000.

The more courageous returned to their properties and endeavoured to carry on, but three years later, in 1809, a flood of even greater magnitude brought about similar scenes of desolation. Good seasons rewarded the efforts of those who stuck to their properties till 1812, when a particularly abundant crop was harvested and a great deal of wheat was fed to livestock. This proved very unfortunate, as there followed three years of comparative drought, when wheat again went as high as 23s. 4d. per bushel, and a series of flood years during which grain had to be imported from Tasmania, India and other places. Most of the land originally cultivated in the neighbourhood of Parramatta was gradually withdrawn from agriculture owing to rapidly diminishing yields of grain, and passed into the hands of the pastoralists. Some of the better soils at Prospect Hill and Castle Hill held out a little longer than the rest, but the stability of the food supply depended too much on land subject to periodical floods.

The damage caused by these was considerably mitigated by a wise order of Governor Macquarie that sites on the higher land

above flood level should be reserved as places of residence for the farmers on the low-lying ground so that human lives, household goods and some of the livestock might at least be secure.

Agriculture gradually extended into the Illawarra district, the Hunter valley and the southern highlands, although the cost of transport to the chief market at Sydney acted as a deterrent.

As time went on, wheat diseases, especially rust, became more and more serious owing to the heavy rainfall and atmospheric humidity in the county of Cumberland and the Illawarra district, and this tended to divert the principal agricultural industry to the more inland districts and to the other Colonies which were gradually growing up.

The greatest improvement in the general agricultural picture in New South Wales at this period was the gradual change from the spade and the hoe to ploughs, harrows and cultivators, although harvesting methods still remained extremely primitive. The agricultural industry in New South Wales, however, was quite secondary to the pastoral industry, which developed by leaps and bounds even before the active squatting period began.

In the early twenties, as the result of Bigge's report, many free settlers of the right class arrived and gradually occupied much of the country in the upper valleys of the Nepean and Hunter rivers and the Goulburn and Bathurst districts, where many of them combined the growth of wheat and other cereals with pastoral pursuits.

The serious drought in New South Wales in 1828-30 also helped to divert wheat-growing and the general agricultural industry to the other Colonies. By 1850 Tasmania had almost as large an area under crop as New South Wales, Victoria had come into the picture with 52,000 acres, and South Australia had begun to realize her wheat-growing possibilities. Eight years later the area had more than doubled and the four leading Colonies had between them over a million acres under crop, the order of acreage being Victoria, South Australia, Tasmania and New South Wales. Even this increase, however, was insufficient to cope with the food requirements of the greatly increased population which resulted from the gold rush.

CHAPTER XVI

South Australia and the Wheat-growing Industry

THE year 1843 is noteworthy for a discovery which entirely altered the practice and prospects of wheat-growing in Australia. Owing to the comparatively small yield per acre necessitated by the climate, it became more and more obvious that wheat-growing must be carried out as a large-scale industry to be an economic success. With the more thorough clearing of the land which became practicable as time went on, it was possible to plough, harrow and sow quite large areas by increasing the number of furrows per plough, the width of the harrows and the size of the horse teams from two up to six or eight. The limiting factor was the time required for harvesting with the scythe or even the sickle, especially as the crop ripened very quickly in the hot dry atmosphere of the Australian summer season.

Bell's reaping machine, invented in Scotland in 1828 on the principle of the lucerne mower used up to the present day, could not be of much help, since it still meant binding into sheaves and stooking in the field for a period before either stacking or threshing direct from the stook. As so few domesticated animals in Australia require to be housed, the straw had little value and was frequently burned. It was realized, therefore, that a machine was required which would remove the heads from the ripe crop, leaving the straw to stand, and this led to the production of Ridley's stripper, which does exactly that.

Owing to the prevailing shortage of labour in South Australia, the prospect of harvesting the wheat crop of 1843 appeared to be an almost hopeless task. A self-appointed group of men, including some farmers, formed themselves into an association known as the Corn Exchange Committee or the Market Committee, one of whose functions was to encourage the mechanically minded amongst the small community to devote themselves to the production of more expeditious and economical methods of harvesting. They proved a very live body and early in September of that year they convened a meeting to be held on the twelfth of the same month, at which potential inventors were asked to

submit models or plans for an improved type of harvester, offering a prize of £40 to the most successful exhibitor. Some sixteen designs in all were exhibited and carefully studied by the committee at subsequent meetings on 19th, 20th and 21st September. The committee's decision was that none were good enough, and the prize was not awarded, although a model submitted by J. W. Bull of Mount Gambier actually contained the principle on which subsequent success was attained. John Ridley, a young miller of an inventive turn of mind, who had brought out with him from England a Watt engine with which he ground the first flour in South Australia, did not compete, although a friend of his actually informed the meeting that Ridley had a harvesting machine in course of construction. He gave his first demonstration about a month later, but it could be regarded as a failure, possibly partly because the wheat was not sufficiently ripe. He made further improvements on the machine and a month later still, on 14th November, gave a demonstration which was voted a complete success. F. S. Dutton in his account of the early days in South Australia, thus describes it:

> The heads of the corn (wheat) were threshed off perfectly clean and, a winnowing machine being at hand, the corn was transferred out of the reaper into the latter machine and carts were ready to convey the cleaned wheat to the mill two miles off, where the wheat, which an hour before was waving in the fields in all the lustre of golden tints, was by Ridley's steam engine ground into flour.

In this first public trial seventy acres of wheat were reaped and threshed in seven days. The principle of the machine was comparatively simple—horizontal projecting combs which held the ripe ears in the correct position to be stripped off by revolving beaters driven by belts from the wheels of the machine, the partly threshed heads being collected in a large box behind the beaters. The broken heads were afterwards removed from the box when it was nearly full and subjected to treatment by winnowers and sieves before the clean grain could be bagged. It really necessitated the labour of four men (five at first), one driving the horses, which at first pushed the stripper ahead of them, one attending to the machine as it went along, adjusting the level of the comb to the varying height of the crop, while three others were usually required for the winnowing, sieving and bagging of the grain. Later on, the principle of side-draught was introduced and only one man was required on the machine

to attend to both horses and comb. Four men thus did in a single day what it took the equivalent of two men for the whole harvesting season to do before.

It would be difficult to exaggerate the importance of this improved harvesting device to the wheat-growing industry. It is only fair to repeat that one of the exhibitors at the competition referred to—J. W. Bull—included in his model the essential features of Ridley's stripper, namely, the projecting comb and the revolving beaters. Dr G. W. Sutton, after a very careful analysis of all the available evidence, regards Bull as the real inventor of the stripper, although he fully acknowledges John Ridley's very important role in actually producing the first practical machine. According to him, Ridley borrowed the main principle of the machine from Bull. So far as we know, Ridley knew nothing of Bull's idea till 19th September, and it seems highly improbable, knowing the set-backs inventors and constructors of new machines invariably have, that he could have produced a machine based solely on Bull's ideas which worked almost perfectly on 14th November. It seems much more probable that he had been working on the same idea for several months at least. Besides, it is difficult to imagine a man of Ridley's high character failing to acknowledge his indebtedness to Bull if he really got his main idea from him. Ridley took out no patent for his invention, and refused to make any profit, although he could have made a fortune out of it. It was not long before several firms were manufacturing the machine, whose fame and use slowly spread to the other Colonies. Indeed, Ridley's stripper, with some modifications, became the universal harvesting machine throughout all the mainland States for forty or fifty years, when it was superseded by the combined harvester produced by H. V. McKay, which removed the heads of wheat in the same way but completed the threshing, winnowing, sieving and bagging as the machine went along. This meant harvesting at approximately the same rate, depending on the width of the comb, but reduced the normal number of men in the harvest field from four to two—one on the machine and the other sewing the bags. Indeed, the evolution of wheat harvesting machinery suitable to our conditions by Australians themselves has been an important factor in enabling the Commonwealth to compete successfully since the beginning of the century in the markets of the world, and is every bit as creditable as the parallel developments in Europe and America.

Still another mechanical invention which greatly speeded the

progress of the agricultural industry we owe to South Australia. Whatever the nature of the forest covering, it is a difficult task to get the land completely clear of roots, stumps and other obstructions so that the ordinary set ploughs can be used satisfactorily. This is particularly true of mallee country, which forms quite a considerable proportion of the wheat belt in South Australia, Victoria and Western Australia.

In 1876 R. B. Smith, of Ardrossan, South Australia, assisted by his brother, C. H. Smith, evolved the simple but ingenious stump-jump plough, which overcomes the difficulty. Any one share of a multiple-furrow plough, on striking an obstruction of any kind, automatically rises and passes over it and re-enters the ground. The same principle can be applied to certain types of cultivators, with the result that millions of acres have been used for cereal-growing which otherwise would have remained uncultivated for a much longer time.

In spite of these improved devices, the yield of wheat in South Australia rapidly declined, until for a whole decade it averaged under five bushels per acre. Weeds became a serious pest on land kept under continuous wheat-growing, and a few progressive farmers occasionally cultivated their land without a crop for nine months or so with the object of getting rid of them, and thus improved their yields. This practice of the cultivated fallow helped matters considerably, but it was obvious that something else was wrong, probably a soil deficiency of some sort. The South Australian government, therefore, resolved that it was time to appoint a Professor of Agriculture and to establish an agricultural college or experiment farm where field trials with artificial fertilizers, amongst other things, could be carried out. Professor Custance was therefore brought out in 1881 as director of agriculture, and later as first principal of Roseworthy Agricultural College. He straightway designed a series of field fertilizer trials after the manner of those conducted at the historical Rothamsted Experiment Station in England.

Now the three main ingredients in fertilizers are nitrogen, potash and phosphates. The soil at Roseworthy showed no response to potash, very little to nitrogen, but a very marked response to phosphates, especially the most soluble form occurring in superphosphate, which Sir John Lawes of Rothamsted had patented as long before as 1843. Professor Custance did not stay very long, and was succeeded in 1887 by Professor William Lowrie, a graduate in agricultural science of Edinburgh University. He repeated and amplified Custance's experiments at

Roseworthy and on a number of private farms. These convinced him beyond a shadow of doubt that on typical wheat lands in South Australia it was profitable to apply from one to two cwt. per acre of superphosphate to the wheat crop, and he carried out a vigorous campaign amongst farmers to get them to adopt the practice. Some heeded his advice and profited by it to the extent of at least £1 per acre, whilst others were sceptical. He also looked carefully into the question of the cultivated fallow, pointing out that in additon to destroying weeds it conserved moisture in the soil and encouraged the bacterial processes which render the nitrogenous constituents of the organic matter incorporated with the soil available to crops.

He was thus mainly responsible for the introduction of two of the most important factors in successful wheat-growing in Australia. He was rather disappointed with the response of the farming community to his teachings and was definitely overworked in his dual position as director of agriculture and principal of the college. In 1901, therefore, he accepted the position of principal of Lincoln Agricultural College in New Zealand.

He had not been there long when there was a widespread demand for his return to South Australia, as the two practices he had advocated, as well as some others, were proving remarkably successful and profitable. His own experiments at Roseworthy gave an increase of seven bushels per acre through the use of superphosphate, and in other parts of the province it was proportionately greater. In some of the mallee districts, indeed, it is impossible to get a crop of any kind without it, and many of the farmers would as soon think of leaving out the seed wheat as leaving out the superphosphate. The practice of applying superphosphate spread to the other Colonies and made such rapid headway that today there is scarcely an acre of wheat sown in South Australia, Victoria, Western Australia and the southern three-quarters of the wheat belt of New South Wales without a dressing of superphosphate.

The most important limiting factor in the growth of wheat is the rainfall during the growth of the crop—April to October, or May to November, according to the district. It is a matter of the greatest importance in most seasons to have a reserve of moisture in the soil and subsoil at seeding time and this can only be assured under the climatic conditions of South Australia if fallowing is started near the beginning of the period of maximum rainfall. The adoption of this practice in the greater part of

the wheat belt of Australia has been almost as important as the introduction of superphosphate.

Lowrie was careful to warn the farmers against the practice of continuous cropping (alternating fallow with one or two wheat crops) because of the danger of depleting the organic matter and humus in the soil—a warning which unfortunately was too frequently neglected. He was a great advocate of the combination of sheep (especially fat-lamb raising) with wheat and having one year in three at least devoted to pasture. Incidentally, the residual effect of the superphosphate greatly benefited the so-called pasture, which consisted mainly of self-sown wheat, black oats and annual grasses and legumes like the trefoils.

Lowrie thus made important contributions to all except two of the factors which have been responsible for the success of wheat-growing in recent years—superphosphate, fallowing, rotation of crops and the combination of sheep with wheat. The other two—mechanical labour-saving devices and the breeding of new varieties more suitable to the Australian environment—were outside his sphere. We have already seen South Australia's part with regard to the former in the evolution of the stripper and the stump-jump plough and even with regard to the latter; Marshall of South Australia produced two varieties which were widely grown throughout Australia—Marshall's No. 3 and Yandilla King—although his work was rather overshadowed by that of Farrer in New South Wales. Professor Lowrie afterwards returned to Australia as director of agriculture in Western Australia, and finally occupied a similar position in his original State of South Australia. In both of these positions he did very good work, but he will be best remembered for his early achievements in South Australia, which cause him to be ranked amongst the greatest benefactors to Australian agriculture. In spite of its late and somewhat unhappy beginnings, South Australia developed into the leading State from the agricultural point of view and was soon exporting wheat to all the other mainland States, and before the end of the century, to oversea countries as well. In addition, the migration of South Australian farmers, with their up-to-date methods, to Victoria, New South Wales and Western Australia, greatly improved the general technique of wheat-growing throughout the Commonwealth.

CHAPTER XVII

Agricultural Progress in Victoria

WHILE New South Wales and Queensland were still concentrating on pastoral expansion, Victoria soon followed South Australia with a marked advance in the agricultural, and especially the wheat-growing, industry.

Up till 1850 the settlers in the southern part of Victoria, following in the wake of Batman and the Henty brothers, slowly and gradually developed, chiefly for pastoral purposes, an ever-expanding area of land radiating from Port Phillip and Portland Bay, while the squatters from the north were utilizing the bulk of the land to the south of the Murray, from the mountain ranges in the east up to the mallee in the west, with their flocks and herds. The State had then a population of only 76,000 with about 50,000 acres under cultivation. Then came the gold rush, one significant result of which was that the population increased to 500,000 by 1860, or nearly twice the population of the whole of Australia twelve years before. This meant a sudden demand for increased food supplies at a time when a considerable proportion of the farming population had been attracted to the diggings. Importations of wheat became necessary from South Australia and several places outside the Commonwealth. The high price obtainable for vegetables and fruit gave a considerable stimulus to the horticultural industry, while some of the minor branches of animal husbandry, like pig- and poultry-farming, were also encouraged. The multiplication of small holdings for these purposes round Melbourne, Geelong, Ballarat and Bendigo originally gave rise to the description of Victoria as the "garden State".

Gold-mining gave employment to many more men for a longer time than in New South Wales, and it was not till the late sixties that the demand for land on the part of ex-miners became really insistent. The very liberal Land Act of 1869, on much the same principle as the Robertson Act of 1861, was the means of settling large numbers of them on properties suitable for wheat-growing. At first this was only a scattered industry con-

fined mainly to the western and central districts, but it gradually spread north into the domain of the squatters, although its rapid expansion had to await railway development.

By 1873 some 964,000 acres were under crop, of which 350,000 acres were devoted to wheat for grain. In the eighties, attention was directed to the Wimmera district, with its rich clay soils, which proved rather intractable at first. The advent of some South Australian farmers with their advanced methods of fallowing and the use of superphosphate brought about a transformation, and it soon developed into the most productive wheat-growing area in the whole of the Commonwealth.

By 1875 Victoria had become self-supporting in the matter of wheat, and it soon raced ahead to rival South Australia in production and to become an exporting Colony, in spite of its much larger population. It had a distinct set-back in the late seventies and early eighties, through a series of dry years and the rabbit invasion, but by 1883 Victoria had 1.5 million acres under wheat out of a total area under cultivation of 2.2 million acres, which increased to three million acres in 1893. By the latter year the industry had extended into the southern end of the great area of mallee country in the north-west, aided by the use of the mallee roller and the stump-jump plough. The extension of a well-devised railway system caused further expansion into the northern district and the mallee right up to the end of the century, when Victoria had become the leading wheat-growing Colony, with a total area of two million acres.

Just as important as that, Victoria was the pioneer Colony with regard to the development of irrigation farming. Its introduction was due in the first place to the initiative of Alfred Deakin, who was elected to the Victorian Parliament in 1879 when only 23 years of age. The drought years at that period made such a vivid impression on him that he eagerly took up the cause of irrigation, to which he devoted his main endeavours for the next ten years or so.

At the age of 28 he was appointed chairman of a royal commission to investigate the possibilities of irrigation, and early in 1885 the commission visited America to report on achievements there. His official report, *Irrigation in Western America*, was a model in its way, and was afterwards printed in the United States as a text-book on the subject. While in Los Angeles he met George Chaffey and this led to the creation of the pioneer irrigation colony at Mildura little more than a year later.

George Chaffey and W. B. Chaffey were young Canadian

brothers who had already established two successful irrigation settlements in California, the larger being called Ontario after their native province. In his report, Deakin stated that "the party was more impressed by Ontario than anything seen in America", but there is no evidence that Deakin dared to hope that Victoria could possibly have the good fortune to attract the Chaffeys there.

After Deakin had departed, a journalist called Cureton extolled the attractions of Australia to such an extent that the Chaffeys sent him to Victoria to interview Deakin. Cureton, without any authority, reported that unlimited land could be obtained from the Victorian government for the introduction of scientific irrigation, with the possibility of a cash bonus in addition.

As a result, George Chaffey, being of an adventurous turn of mind and attracted by a return to the empire as a British subject, thereupon booked his passage to Australia and arrived in Sydney in February 1886. Before many weeks he cabled to his brother to sell their interest in Ontario and come to Australia as soon as possible.

With the limited time at his disposal, W. B. made rather a poor bargain, which did not please his brother, as it left them with much less capital than he had hoped for. Mrs George Chaffey and family arrived in Melbourne in September, and W. B. before the end of the year.

In the course of a trip up the Murray, George Chaffey called in at Mildura station, a pastoral property of 250,000 acres, which would have had no attractions whatsoever to anyone who had not the possibilities of irrigation in mind. It was mainly covered by mallee scrub which at the time of his visit had been reduced to practically nothing by drought and rabbits, and had a normal carrying capacity of one sheep to twenty acres. Although the annual rent was only one penny for fourteen acres, the owner had been losing money on it.

An agreement was signed between Deakin and George Chaffey on 21st October 1886, the main provisions of which amounted to this, that the Chaffey brothers should spend the sum of £300,000 within four years on irrigation works and improvements in return for the use of water from the Murray and the right to purchase the land at an effective price of 17s. 1d. per acre. The Chaffeys had to take all the risks of a very large expenditure on plant and of being able to sell the land at a profit when developed. The Victorian government took no risks and

had the tremendous advantage of the unique technical skill and experience of the Chaffeys, the large expenditure of capital and the prospect of an industrious and closely settled population producing valuable commodities from land that was practically worthless as it stood. One would have thought that the agreement would have been enthusiastically welcomed by the Victorian Parliament, but the opposition insisted on the "concession" being put up for tender, and it was advertised on 1st January 1887.

In the meantime, Sir John Downer, attorney-general for South Australia, approached George Chaffey and invited him to investigate land for an irrigation scheme on the Murray in his own State, and Renmark was finally selected as a suitable site, which the Chaffeys promised to develop.

There was great consternation in Victoria when it became known that the Chaffeys were committed to the development of Renmark and had refused to tender for the Mildura project, especially as no other individuals or companies had submitted a tender when the limiting period of two months had expired. The Chaffeys, however, were persuaded to adopt the original agreement to which they had given so much thought. The Crown law department put it in legal form, but it was worded in such a verbose manner that it gave rise to many subsequent misunderstandings. The "indenture", as it was called, was signed on 31st May 1887, and the company of Chaffey Brothers Limited was formed with a capital of £350,000. It was really a colossal task which this new company undertook, and it could never have been brought to fruition without the combination of engineering skill, irrigation experience, courage and business ability which the brothers possessed between them.

To begin with, nowhere in the world had water been raised to irrigate thousands of acres to such a height as was required at Mildura. George Chaffey himself designed a novel type of large pumping plant which it took the well-known British firm of Tangye's three years to make and deliver. In the meantime, he showed great ingenuity in devising temporary substitutes, buying an old river-boat and converting it into a pumping barge to keep King's billabong full and using a temporary pump to raise the water from it to the 50-foot level. This made irrigation possible two years earlier than would otherwise have been the case.

There was no railway within 150 miles of Mildura at that time, and the steamer service on the Murray was infrequent and unreliable. In spite of that, he managed to assemble the

gear, to clear and grade the land, to construct miles of irrigation channels and to lay out the whole irrigable area as well as the town.

In the beginning of 1888 settlement began, many of the settlers coming from Britain, where an active advertising campaign was carried on. Two years later this corner of a worn-out sheep-run had a population of 3000, including 950 resident settlers with their families; 6500 acres had been cleared with 4500 under cultivation, including 900 acres planted with vines and fruit trees, all in a flourishing condition. Before the end of the century nearly four million lb. of raisins and five million lb. of currants were being produced annually, and by 1903 the value of the products of the irrigated land exceeded £280,000. Long before this, however, the Chaffeys had been forced into liquidation by the depression of the nineties, which affected Victoria more than any of the other Colonies, by the actions of their enemies and by the rather unsympathetic treatment of the Victorian government. George Chaffey returned to California, where he was mainly responsible for one of the largest and most successful irrigation schemes in the whole world, the Imperial valley irrigation project. With his son, who became president of the California Bank at Los Angeles, he engaged in the banking business and he became one of the wealthiest and most respected men in the western States of America.

W. B. Chaffey remained at Mildura, where he was mainly responsible for the successful development of the dried fruit industry, and he retained the respect and affection of the whole settlement till he died in 1926. A third brother, Charles F. Chaffey, came to manage the project at Renmark, where he and his family remained till the settlement was well on its feet.

The work of the Chaffey brothers in proving the practicability of irrigation at Mildura and Renmark has been of immense importance to the whole of Australia, as it paved the way for that ever-expanding chain of irrigation settlements which have added so much to the value of rural production and to the happiness and well-being of thousands of successful farmers on small holdings.

CHAPTER XVIII

Fruit Culture and Viticulture

AUSTRALIA has such a wide range of climatic conditions that nearly every kind of fruit, from cool climate to tropical, can be successfully grown within her borders. Besides the variety of fruits introduced in the early days, many others were tried, and by degrees the most suitable localities for each discovered, mainly by trial and error. In the neighbourhood of Sydney and Parramatta oranges, lemons, peaches, apricots and plums succeeded, although the climate was a little too warm for the ideal growth of apples, pears and cherries. A better environment for them was found in the neighbourhood of Hobart, in Tasmania and on the cooler tablelands of New South Wales in such areas as Goulburn and Bathurst. Tasmania was also found to be the most suitable location for gooseberries, currants and raspberries, and in the course of time a surplus above home consumption was produced, enabling a start to be made with the jam-making industry, which had assumed considerable proportions before the end of the century. Strawberries also do best in the cool climate of Tasmania, although the season there is short, as it is in Britain. It was found, however, that they thrived quite well in the cooler seasons of the year as far north as southern Queensland, so that they became available at almost any time of the year.

The most successful grower of oranges in the very early days was Rev. Richard Johnson, and most of the properties in New South Wales had some orange, lemon and mandarin trees growing to improve the amenities of living. Citrus-growing spread along the coast to the north and south of Sydney, and when the Hunter valley was opened for settlement oranges found a very suitable habitat there. Peaches and apricots are found to flourish under similar climatic conditions of good rainfall, warm temperate climate and freedom from severe frosts, and as the different varieties ripen over a lengthy period in the summer months, an almost continuous supply of fruit was available throughout the year. A later introduction, the passion fruit, which also has a fairly long bearing season, was found to grow with the greatest

of ease in this region also. At first all of these were simply grown for consumption on the properties where they were planted, but enterprising settlers were soon growing most of them on a commercial scale and sending them to market, either as a side-line or as their main means of support.

When the new Colonies of Victoria, Western Australia and South Australia were founded, most of the new settlers followed the example of New South Wales and Tasmania and gradually discovered which fruits were most suitable for their particular environment. Thus Victoria began to specialize in the production of apples and pears in the vicinity of Melbourne, whilst Adelaide and Perth had most success with peaches, apricots and grapes. As settlement proceeded north, the new Colony of Queensland discovered areas suitable for the growth of semitropical and tropical fruits like bananas, pineapples, papaws and mangoes near the coast, and apples, pears and grapes on the southern highlands in the neighbourhood of Stanthorpe. An intercolonial trade thus gradually developed, each Colony supplying the others with those fruits which she could produce in excess of local requirements. The influx of European settlers during and immediately after the gold rush stimulated the fruitgrowing industry, and more and more settlers devoted the whole of their attention to this intensive form of land use.

The rate of progress kept pace with the increasing population, and although a few items like Californian oranges and Fiji bananas were imported, a small export trade developed, the largest single item being apples from Tasmania.

Towards the close of the century, a new avenue for the extension of fruit-growing had been opened by the development of irrigation in the inland districts, which led to a great increase in the area under oranges and grapes, and ultimately under peaches, apricots and pears for canning.

By the time of federation, 145,000 acres were under commercial orchards and fruit gardens, and the net exports amounted to £122,000 worth of fresh fruits and £41,000 worth of jams and jellies.

Viticulture

It is difficult to get exact information regarding the pioneers and benefactors of the fruit-growing industry, but it is otherwise in connection with viticulture and wine-making, partly because they deal with a single species and partly because most of the firms which have been responsible for the production of our

finest wines are still carrying on after a century or more of activity.

The grape vines originally imported from South Africa did not succeed owing largely to a lack of skilled viticulturists and the occurrence of disease. Gregory Blaxland at Brush Farm was the first to overcome these difficulties and actually succeeded in exporting a little wine about 1823. His operations were carried out on a small scale only, and the first people to succeed with large-scale viticulture and wine-making were John Macarthur and his sons, James and William, at Camden Park.

It will be remembered that during his second period of exile John Macarthur went over to the continent and made a special study of the industry in France and Switzerland. He brought back with him cuttings of most of the leading wine-making varieties of the continent, and in 1820 planted quite an extensive vineyard on land sloping down to the Nepean River. The wine made from them was of higher quality than that produced from the South African vines, and most of the varieties appeared to be resistant to the prevailing disease, anthracnose. Indeed, in 1841 the Camden Park vineyards secured high awards in London for both wine and brandy.

The Macarthurs for a time experimented with the growth of vines from seed, evidently thinking that they might get varieties or strains better adapted to Australian conditions. For reasons which are quite understandable in the light of recent knowledge, the results were very disappointing. Cuttings from the Camden Park vineyard were, however, for a time the chief source of material for all the other viticulturists who started operations in the 1820s.

One of the greatest benefactors of the infant industry was James Busby, who arrived in Sydney with his father in 1824, after studying viticulture and wine-making in France. Amongst other things, he was the author of three books dealing with the technique of both branches of the industry. Soon after his arrival he took a position at the Cabramatta Orphan School, where he planted a small vineyard and gave instruction in the practice of viticulture. In 1831 he went to England and the continent and brought back with him in the following year no fewer than 650 of the best commercial varieties he was able to pick up after an extended tour. These were planted out in the botanic gardens, Sydney, and it says a great deal for the careful manner in which they were packed at Kew gardens that the vast majority of them struck successfully and bore fruit after

their long voyage. Lack of demand and the incursions of nut-grass caused them to be uprooted some years later, but fortunately Busby himself planted 365 duplicates on a 2000-acre property, Kirkton, which he had acquired in the Hunter River district. Busby left for New Zealand in the following year, and Kirkton was run by his father for a period, and afterwards passed into the hands of the Lindeman family. The Kirkton collection proved an invaluable source of varieties afterwards used throughout all the vine-growing districts of Australia.

One of the objectives of the Australian Agricultural Company was the encouragement of viticulture and wine-making, but its efforts in this direction were not very notable.

An important vineyard was established in the Hunter River district by James King of Irrawang in the early thirties, and he gained a high reputation and several awards for the quality of his wines, both at home and abroad. Others were started by Jules Joubert, who introduced some vines direct from France, and by Dr H. J. Lindeman, who established a vineyard at Caworro in 1840.

One of Dr Lindeman's sons planted another vineyard at Pokolbin called Ben Ean and established a winery and distillery there, purchasing grapes from adjacent vineyards as well as using those produced on his own properties. As the business grew the firm bought up several other properties, including Kirkton and Sunshine and gained a reputation for its light dry beverage wines.

In 1840 Wyndham planted Dalwood vineyard in the same region. This was afterwards taken over by the Penfolds and extended till it became one of the largest in the district.

Up till 1850 New South Wales was the chief vine-growing and wine-making Colony, and the industry was mainly confined to the flats and slopes in the valley of the Hunter and its tributaries.

The next extension of the industry in New South Wales was to the Albury-Corowa district, close to the Murray River, where the Lindeman firm was again one of the pioneers. The grapes grown there have a higher sugar content and are more suitable for the making of sweeter and heavier dessert wines.

Dr McKay started a vineyard and winery near Rooty Hill, just about 25 miles to the west of Sydney. He afterwards sold this famous Minchinbury property to James Angus, who extended the operations considerably and succeeded in manufacturing a really satisfactory sparkling wine. It afterwards passed into the hands of the well-known South Australian firm of Penfold's

Wines Ltd which built up a fine reputation for its champagne type of wine on the sound foundations laid by Angus.

Victoria was the next Colony to engage in the industry, and in 1838 a vineyard was established at Yering, near Melbourne, by William Pyrie. Before twenty years had elapsed the district had about 3000 acres under vines for table grapes, as well as wine-making. Shortly afterwards a number of vineyards were planted in the neighbourhood of Geelong, which flourished until a terrible disaster occurred which threatened the ruin of the industry in the two eastern Colonies. This was the first appearance, in 1877, of the dreaded phylloxera pest, which decimated the Geelong vineyards as it had done many on the continent of Europe. The phylloxera insect is an aphid which attacks the roots of the vine in such a virulent fashion as to defy any known remedial measures. The Victorian government ordered the complete destruction of the vines and the sterilization of the soil. £50,000 was paid in compensation, and every encouragement was given to the planting of vines in districts free from the trouble, including a bonus of two pounds per acre. This last inducement led to rapid expansion at first in the Bendigo district, where, however, phylloxera appeared in 1893 with similar results to those at Geelong.

There was still greater activity in the neighbourhood of Rutherglen to the south of the Murray in the same climatic zone as Albury and Corowa on the New South Wales side of the river. It soon became the leading vine-growing centre in Victoria, if not in Australia, with the Burgoynes as perhaps the most prominent manufacturers of wine. But unfortunately phylloxera appeared there just before the end of the century and most of the vineyards died out or were uprooted. By this time, however, a complete but expensive remedy for the trouble had been found, and the area was gradually replanted with cuttings of the favourite varieties grafted on to phylloxera-resistant stocks imported from America.

Another area in Victoria to achieve success in wine-making was in the western district, when Joseph Best planted a vineyard in the sixties which he afterwards sold in 1887 to Hans Irvine, who gained some renown as the first producer of good sparkling wines in Victoria. The well-known South Australian firm of B. Seppelt and Sons afterwards acquired the business and carried on the good work.

In the later years of the century great new prospects for viticulture had opened out with the development of irrigation at

Mildura, although the majority of the varieties were grown for the production of dried products of the vine—sultanas, lexias and currants. Fortunately the irrigation areas in all the Colonies remained free from the ravages of phylloxera and the dried products of the vine became an increasingly important commodity on all the irrigation settlements along the Murray River.

When the province of South Australia was founded in 1836 it was soon discovered that the soil and climate in many districts within easy reach of Adelaide were admirably adapted for the culture of the vine. It was fortunate, therefore, that A. H. Davis had the foresight to obtain a large collection of the Busby introductions and to have them planted in the Adelaide Botanic Gardens, as they became the chief source of material for the enterprising viticulturists of South Australia. The first man to establish a vineyard in South Australia, however, seems to have obtained his cuttings mainly from Camden Park. He was John Reynell, who planted a vineyard in 1839 at Reynella in the southern hills about fourteen miles from Adelaide, and his example was followed by others who occupied the slopes near by. A little farther south Dr Kelly established Trinity vineyard in 1842 and Tintara in 1863, and at both he suceeded in manufacturing dry wines of good quality. Tintara was later purchased by Thomas Hardy, founder of the firm of T. Hardy and Sons.

In 1844 Dr Rawson Penfold started a vineyard at Magill, just about four miles to the east of Adelaide, with cuttings which he had brought from the continent. He gradually increased the area of his Grange vineyards, and the firm of Penfold's Wines Limited, as already indicated, extended its activities to the other Colonies, purchasing several going concerns like Dalwood and Minchinbury in New South Wales.

Much the most extensive area in South Australia devoted to successful viticulture is in the famous Barossa valley, forty or fifty miles to the north-east of Adelaide. A large proportion of the early settlers there were Germans and some of them entered the industry with previous experience. It is impossible to mention all the names of firms and individuals who have made this district famous for the quality of its products, but amongst the pioneers were Samuel Smith of Yalumba, Johann Gramp, who produced wine from his Orlando vineyard as early as 1850, and J. E. Seppelt, whose operations began in 1851 and from whose activities the firm of B. Seppelt and Sons gradually grew into one of the biggest organizations of its kind in Australia.

Another viticultural area in the Clare and Watervale districts lies about eighty miles due north of Adelaide and, although not so extensive as the Barossa valley, produces some of the best light wines made in Australia. Two of the leading firms responsible for this fine effort are Buring and Sobels of Springvale, and the Stanley Wine Company, which chiefly used grapes purchased from individual growers.

Up till near the end of last century Victoria and South Australia were keen competitors for supremacy in wine-making and the viticultural industry generally. South Australia fortunately escaped the ravages of phylloxera and thus gained the advantage in the race, which she has sustained up to the present day.

Some of the vineyards in New South Wales, especially those near Sydney used for the production of table grapes, were never re-planted, and the industry has lagged behind that of the two southern States.

Vines were introduced at quite an early period in the history of Western Australia, and the growth of grapes for table use as well as for wine-making proceeded rather slowly. Owing to her greater proximity to places like Ceylon and India she has a distinct advantage over all the other States in the export of table grapes.

Except on the southern tablelands, the climate of Queensland is not very suitable for the viticultural industry, which is confined mainly to the growth of table grapes at Stanthorpe and surroundings.

At the time of federation the area under vines in the various Colonies was approximately as follows: Victoria, 30,000 acres; South Australia, 20,000; New South Wales, 8500; Western Australia, 3000; and Queensland, 2000; and amongst them they were producing about five million gallons of wine annually, in addition to supplying the demand for table grapes and making a rapidly increasing contribution to the requirements for the dried products of the vine. Indeed, if it had not been for the occurrence of phylloxera, the production of wine in Australia might have exceeded the local consumption before the end of the century, and markets may have been sought for her surplus abroad. Although there was a good deal of prejudice in our main potential market, Britain, against "colonial" wines, there was abundant evidence that the quality was improving and Australian wines had actually received high commendation at several exhibitions on the continent.

CHAPTER XIX

Miscellaneous Crops

WHEAT occupies such a pre-eminent place amongst farm crops in Australia that many people regard the agricultural industry and the wheat-growing industry as synonymous terms. It is true that wheat, grown for grain and hay, usually occupies something like seventy per cent of the area under crop, but there are quite a number of others whose progress is worth recording.

Other Cereals

We have already seen that the crop second in importance in the early days of colonization was maize, and it is still a considerable factor in the agriculture of many districts in New South Wales and Queensland. It has much more exacting soil and climatic requirements than wheat, needing a good summer rainfall, freedom from severe frosts and a richer soil to give satisfactory crops. The Hawkesbury River flats suited it admirably except in dry seasons, and quite good yields were obtained there from the earliest times.

As each new coastal river was discovered and settled, especially to the north of Sydney, maize-growing, often combined with dairying, became the leading industry on the alluvial soils on the banks of the Manning, the Hastings, the Macleay and the Clarence. So disappointing were the results when it was tried on the poorer land that it became almost taken for granted that it was a crop which should be confined to alluvial soils, although in the United States and other countries quite good results were obtained on upland soils with proper attention to fertilizing and general field technique. The yields obtained under these favourable soil conditions in New South Wales were very good, although the general standard of farming practice, in such matters as seed selection and weed control, was not particularly high. Before the end of the century the cultivation of maize had extended to Queensland, which has a much larger area with the proper climatic environment, and to north-eastern Victoria, where remarkably good crops were obtained on

the Snowy River flats. Maize was sometimes used as green feed for dairy cows, for which purpose sweet sorghum was generally preferred because of its greater hardiness and resistance to frost damage when approaching maturity.

In the early days a variety of grain sorghum called Kaffir corn was introduced from South Africa and grown to a small extent, and several spasmodic attempts were made during the century to establish as a commercial crop various types of grain sorghum, which is regarded in several other countries as a substitute for maize. It is considerably hardier than the latter, as it flourishes at higher temperatures, on a lower rainfall and on poorer soils, but it never became popular, partly on account of harvesting difficulties.

Closely allied to the sorghums botanically is another crop used for quite a different purpose, namely, broom millet. The ripe inflorescence when the seeds are removed, is used for the manufacture of brooms. It grows well under the same conditions as those required for maize, and similar cultural methods are used, although special care is needed for the harvesting of the crop and its preparation for market. Its cultivation was taken up towards the end of the century by a number of small farmers on alluvial flats in the coastal, and some of the inland, districts of New South Wales and the requirements of the Australian trade thus, at least partially, supplied.

The European varieties of the common oat require a cooler, moister climate than wheat and so oat-growing was at first mainly confined to Tasmania and the more elevated regions of the mainland. The early introduction of the Algerian oat, which thrives under warmer and drier conditions, enabled the area to be extended considerably. Although the grain of this type is not very plump it produces quite good yields of palatable fodder and, as oats are grown as much for hay as for grain in Australia, it soon became almost the universal variety grown. One of the most difficult problems in Australian agriculture is to find crops which can be grown successfully in rotation with wheat. The Algerian oat with its allies and derivatives is almost the only money crop which can be used in most districts for this purpose, and it gradually grew in favour, especially in Victoria. As a rotation crop with wheat it is not ideal, as it makes very similar demands on the soil, but it has the great advantage that it is not subject to certain soil-borne diseases which greatly detract from the yield of wheat when it is grown almost continuously on the same land. Rotations like, "fallow, wheat, oats"

or "fallow, wheat, oats, pasture" became increasingly popular in Victoria and South Australia. Most of the oats were consumed on the farm, either in the form of chaffed hay or grain, which, with chaffed wheaten hay, formed the usual diet of the working horses.

Cape and skinless barley were early introductions to New South Wales, and they were used chiefly as fodder crops for sheep and cattle by those graziers and dairymen who realized that supplements to natural pastures were required in most years. The two-rowed Chevalier types for malting purposes were tried out in many districts, usually with disappointing results, and considerable quantities of either barley or malt had to be imported by the brewers up to the end of the century. Suitable habitats for the true malting types of barley were ultimately discovered in several districts in South Australia and Victoria and by degrees the supply nearly kept pace with the increasing local demand.

Although it is such an important crop on the continent of Europe, rye has never been very largely grown by British communities, and that is particularly true of Australia. A little has always been grown for early green feed, sometimes mixed with vetches, on dairy farms on account of its hardiness and a few hundreds or thousands of acres for grain in the sandier soils of the cooler districts, chiefly to supply the limited demands of those people who prefer its products to those of wheat. Rye straw is very strong, clean and wiry and has a special value for thatching and the making of horse-collars, and a few acres have always been grown for these purposes.

Hay and Forage Crops

A few of the early settlers occasionally cut some of their improved pastures for hay to supply the needs of their dairy cows and stud sheep, and convicts were sometimes employed to cut the native grasses to supplement the diet of the government horses. Australians, however, have never given much attention to the production of that characteristic British product, meadow hay, which is such an important stand-by during the winter months. Its place in Australia has largely been taken by wheaten and oaten hay which could be handled with much less labour and greater expedition, especially after the introduction of the reaper and binder.

The only other crop used extensively for hay-making during the last century was lucerne. It was an early introduction which

did well from the start on the Hawkesbury flats, although it was a disappointment elsewhere. Lucerne is a perennial leguminous plant with a very deep rooting habit which frequently enables it to tap underground supplies of water not available to other farm crops. Alluvial soils of high fertility readily penetrable by plant roots and usually with a water-table at a reasonable depth suited it to perfection and it was found that on the banks of the Hawkesbury, the Shoalhaven and the Hunter it gave from five to eight successive crops of hay in a single season. Some of this was fed to livestock on the farm, but as the demand for it increased, a greater and greater quantity was baled and sent to Sydney and other centres, where it was popular with owners of stall-fed horses and suburban dairies. Its cultivation was by no means confined to river flats near the coast, as an excellent quality of hay was produced at Maitland, Tamworth and Mudgee, where many small farmers made a living mainly from this single crop.

Other forage crops grown to a small extent were red clover, field peas, vetches or tares, cow-peas, turnips and rape, although most of them had not passed the experimental stage before the end of the nineteenth century.

Vegetable Crops

Vegetables suitable to the climate were grown on most private properties from the beginning of settlement, although there is abundant evidence of neglect by many land-holders of the opportunity to produce a sufficient quantity of these essentials to a healthy diet. After the gold rush, the supply of vegetables to the cities and towns of the mainland was largely in the hands of Chinese market gardeners, who frequently supplied them direct to their customers. The chief vegetable grown on a field scale has always been the potato, although there gradually came into being commercial areas of cabbages, onions, peas, beans and pumpkins planted on farms as side-lines.

The potato is third only to wheat and rye as a food crop amongst the white races, but the *per capita* consumption in Australia is low compared with that in most European countries. It is rather exacting in its soil and climatic requirements. Ideal soils are deep well-drained loams and sandy loams rich in humus or organic matter. Although potatoes cannot stand droughty conditions, there are few crops more easily ruined by water-logging and, although a cool climate crop, they are very sensitive to frosts at all stages of their growth. These general facts were

gradually appreciated by settlers in the various Colonies, and the culture of potatoes was mainly concentrated on river flats and deep red volcanic soils in Tasmania, Victoria and the tablelands of New South Wales. Tasmania and Victoria were soon producing in excess of their own requirements and they developed an increasing export trade with all the other Colonies right up to, and after, the time of federation. Owing to their perishable nature, there was no hope of developing an international trade in potatoes, but in seasons of low production in Australia considerable quantities were imported from New Zealand. The only other vegetable crop which was the medium of inter-colonial trade to any extent during the last century was the onion, which was found to produce very prolifically on the volcanic soils in the better rainfall regions of the western district of Victoria, and the pumpkin, which proved particularly well adapted to the climate of southern Queensland.

Fibre Crops

Fibre crops played only a minor part in Australian agriculture during the nineteenth century. Flax, as we have seen, was grown to a limited extent in the early days of the Colony in New South Wales, and a small quantity of linen goods was manufactured. The industry gradually died out and was not revived till some years after federation.

There were several keen advocates of the establishment of the cotton crop, as the conditions in Australia appeared somewhat similar to those under which it was being successfully grown in the United States. Trials in the neighbourhood of Sydney gave disappointing results, as the growing seasons was not sufficiently warm or prolonged to ensure the proper maturity of the crop. Just about the time Queensland was separated from New South Wales, more successful results were obtained in the northern Colony, and official records show that fourteen acres were under cotton in 1860. The methods and costs of cultivation are very similar to those involved in the growing of maize. The greatest trouble and expense come from the harvesting of the crop which normally can be done only with abundant cheap labour, which was available in other cotton-growing countries with which Australia would have to compete. Careful inquiries showed that Queensland had quite an extensive region with similar climatic conditions to parts of the cotton belt of America, and this encouraged the planting of further areas, though the expense of picking with inexperienced and expensive labour ren-

dered it impossible to compete with countries like the United States, India and Egypt. The high prices resulting from the American civil war gave the young Queensland industry its opportunity and the area under crop actually increased to 14,000 acres in 1870, but, when prices fell soon after, cotton practically disappeared till well past the end of the century.

Tobacco

Tobacco is a crop which can be grown under a great variety of conditions, as evidenced by the wide climatic range of the countries which produce it, from Cuba and Sumatra to Canada and Ireland. There are few crops which are subject to greater variations in quality and price. The valuable cigar-wrapper and cigar-filler tobacco is grown chiefly in the tropics, whilst the production of pipe and cigarette tobacco is mainly confined to the temperate zone.

The quality of the leaf and its burning aroma are dependent on a combination of factors not yet fully understood, including soil, climate and methods of cultivation, harvesting, curing and fermentation. The best quality of cigarette and light pipe tobacco can be grown only on light sandy soils and sandy loams, and flue-curing is essential for the finer grades. The heavier pipe tobaccos, darker in colour and richer in nicotine, are produced on heavier and richer soils. As tobacco-growing in the nineteenth century in Australia was almost entirely confined to rich river flats and volcanic soils, and as flue-curing was practically unknown, the only type produced was a dark and strong pipe tobacco. It was fortunate that this was the type most in demand till near the end of this period.

The plant was introduced in quite early days and was found to be relatively easy to grow, except in seasons with a very dry summer. At first the leaves were simply dried in the sun or under cover in an open shed and the resultant product could not have been very satisfactory. An American immigrant with previous experience of the crop established a small curing plant on the Hunter River, and several growers sent their leaf there for treatment, but even this was of a primitive type. The whole plant or the individual leaves were suspended near the ceiling of a shed while a fire was made on the floor and kept going till the leaves had thoroughly dried out. They were left in position till they re-absorbed some moisture and then piled in heaps,

whereupon a certain amount of fermentation took place with the generation of considerable heat and the darkening of the product. It was then either rolled into a twist or compressed into plugs for sale.

The cultivation and curing of tobacco is an even more intensive industry than vegetable-growing, and one man can deal only with a very small acreage. It did not appeal very much to the average Australian, and, after the gold rush, the growth of the crop was largely taken over by Chinese. The area grown was never sufficient to supply the local demand, and the quality did not allow it to compete very satisfactorily with the imported article. It reached its highest production in 1888-9, when 6600 acres were under crop, of which 4800 acres were in New South Wales and the bulk of the remainder in Victoria. The acreage diminished towards the end of the century, especially as the demand was gradually changing over to the lighter and milder types of pipe and cigarette tobacco.

Sugar-cane

Sugar has long been a commodity of great importance in international trade, and the increasing cost of its importation into Australia drew attention to the possibility of producing it locally. Although there are a few other sources of commercial sugar, the great bulk of the world's supply is derived from sugar-cane which is a product of tropical and subtropical regions, and sugar-beet, a temperate climate crop which was only beginning to attract attention at the time of Australia's foundation. The first serious attempt to grow sugar-cane in Australia was when the penal settlement was founded in 1821 at Port Macquarie at the mouth of the Hastings River, about 280 miles to the north of Sydney. The pioneer of the industry was Thomas Scott, who introduced cuttings from the tropics in 1822. About 600 acres were planted on the banks of the Wilson River, a northern tributary of the Hastings, and some sugar was actually extracted from it. It was found that the climate was not sufficiently warm for the proper maturity of the cane, and cultivation was soon abandoned.

Scott continued his advocacy of growing the crop commercially in northern New South Wales and Queensland. It was tried on the Macleay farther north, but the climate was still too cold. Very promising results were obtained on the Clarence River flats, although it was not till 1865 that much attention was paid to the crop. Equally good crops, which produced a reasonably high

yield of sugar, were obtained by those settlers who took up land on the fertile banks of the Richmond and the Tweed.

For its best development sugar-cane requires a rich, deep, well-drained soil and a good rainfall, especially in the summer months, and the alluvial soils and drained swamps on the river banks, as well as the red loams of the big scrub country, suited it admirably. Many small settlers in the north coast district took up its cultivation, frequently combining it with dairy-farming. It was not sufficient to grow the crop, and means had to be found for extracting the sugar from it. Several small mills with crushing and extracting plant were erected, but the work done by them never reached a high degree of efficiency. This difficulty was soon solved by the Colonial Sugar Refining Company, which erected large extraction mills at Harwood on the Clarence, Broadwater on the Richmond and a little later, at Condong on the Tweed, which were capable of dealing with the total produce in each of these river valleys. It also had a refinery in Sydney which completed the preparation of the sugar for market, and this certainty regarding the disposal of all the cane they could produce gave a great stimulus to the young industry. From the first the company employed skilled engineers and chemists, so that the mechanical part of the work was done efficiently; the growers were remunerated according to the actual sugar content of the cane. They also helped by facilitating the transfer of the cane to the various mills by rail and punt. The industry thus developed at a relatively rapid rate. In 1864 there were only two acres recorded as under cane in New South Wales; ten years later there were 6670 acres, and by 1894 28,000 acres, which area remained fairly constant to the end of the century.

Queensland has a very much larger area with an even better climate for cane-growing, and the cultivation of the crop went ahead much faster there.

It was first grown in the neighbourhood of Brisbane. By 1876 the area under cane in the northern State had passed the acreage in New South Wales, and by 1900-1 over 72,000 acres were harvested and 100,000 tons of sugar produced. Today the value of the sugar produced in Queensland greatly exceeds that derived from any other crop. There are few difficulties in growing the crop in suitable localities, and this was usually carried out by the farmer and the members of his family. The labour involved in harvesting it with cane-knives is somewhat arduous, especially in a tropical climate.

In New South Wales cutting was done almost entirely by

white labour, but the Queensland growers declared that this was impossible, especially north of Bundaberg. Consequently Kanakas from the South Sea islands were introduced (sometimes forcibly) to do the field work, while white labour was responsible for most of the work in the mills. When federation was mooted, one of the most contentious matters was whether the Kanakas should be retained or repatriated, and finally the decision was in favour of a white Australia policy. In spite of many predictions that the industry would die a natural death if coloured labour was not permitted, it has, as we shall see, gone ahead by leaps and bounds with the aid of subsidies and has been of the greatest assistance to Britain and Canada in periods of scarcity due to war conditions.

CHAPTER XX

At the End of the Century

FROM time to time criticism has been levelled at the slow rate of progress in the development of Australia. When it is remembered that each of the six Colonies started from very small and unpromising beginnings in an entirely new and precarious environment far removed from large centres of white population, the progress made in the use of the land and other natural resources in the first 112 years up to the time of federation was very creditable indeed. Critics sometimes fail to realize the difficulties associated with the primitive means of transport in the early days by sailing ships which took from six to eight months for the voyage each way. An unfamiliar continent had to be subdued without a single building and without roads or other means of internal communication. Its more accessible regions were covered by forest which had to be cleared before crops could be grown at all or stock-raising carried out with any degree of success.

Before the end of the period the great bulk of the occupiable land in the huge continent, which had lain practically dormant for countless years, had been put to some kind of use. Australia had become the leading wool-producing country of the world and very much the most important source of the fine merino wool which was in such demand in Britain and on the continent of Europe. In addition to supplying the requirements of its own inhabitants, it had became one of the chief exporters of beef, mutton, lamb, butter, timber, fruit and other products of the soil. All this was achieved in spite of the frequent occurrence in an aggravated form of those droughts and floods and other disabilities which affect primary producers in nearly every country.

Progress is illustrated by the following approximate figures in the table shown on page 127.

A study of the population figures reveals that the quarter-million mark was not reached till 1843, or 55 years after the first settlement, while it was 1852 before the half-million mark

	1788	*1860*	*1900–1*
Population	1,100	1,145,000	3,800,000
Sheep	29	20,000,000	72,000,000
Cattle	7	4,000,000	8,600,000
Horses	7	431,000	1,600,000
Pigs	74	351,000	950,000
Area under crop (acres)	2	1,188,000	8,812,000
Export of wool (lb.)	nil	80,000,000	500,000,000
Export of mutton and lamb (lb.)	nil	nil	66,000,000
Export of beef (lb.)	nil	nil	91,000,000
Export of butter (lb.)	nil	nil	32,000,000
Export of fruit and fruit products (£)	nil	nil	£163,000

was passed. The effect of the gold rushes is illustrated by the increase to one million in 1858, two million in 1877, three million in 1889, and 3.8 million in 1900.

Even the large numbers of sheep and cattle quoted were considerably less than in the early nineties owing to a series of dry years and the failure of anything like adequate provision for the conservation of water and fodder. In 1891 the recorded number of sheep was actually 106 million, while the cattle numbered 12.2 million in 1894.

The comparative progress in the various Colonies is indicated by the following approximate data for 1900-1.

	Population	*Number of sheep*	*Number of cattle*	*Area under crop* (acres)
New South Wales	1,300,000	42,000,000	2,047,000	2,445,000
Victoria	1,196,000	10,700,000	1,625,000	3,114,000
Queensland	494,000	10,000,000	3,773,000	427,000
South Australia	362,000	5,000,000	481,000	2,370,000
Western Australia	180,000	2,600,000	399,000	201,000
Tasmania	173,000	1,800,000	169,000	224,000

At the time of federation about one-third of the population resided in New South Wales, one-third in Victoria and the remaining third in the four other States combined.

Other points brought out by this table are that more than half the sheep were in New South Wales and nearly half the cattle in Queensland. With regard to agriculture, the most notable facts were the large area under crop in South Australia in spite of its small population, and the negligible area in

Western Australia, which was just beginning to realize her wheat-growing potentialities at the time of federation.

This general progress was made with a minimum of technical and research assistance from government institutions until near the end of the period. A few men of scientific attainments, such as government botanists and veterinarians, were employed by some of the Colonies, but nothing akin to the departments of agriculture, agricultural colleges and research stations with which we are familiar today was available till the last two decades of the century. We have already learned something of the contributions of intrepid explorers who paved the way for settlement, of the valuable part played by individual inventors and benefactors, and of the work of the great stud-breeders and their advisers. The main credit for the quite substantial progress must, however, be given to the many thousands of graziers, farmers and settlers who braved the dangers and difficulties of the trackless bush and developed the land industries by the work of their hands and the sweat of their brows and thus built the foundation on which all subsequent advances have been made.

As time went on, agricultural societies gradually grew up with a view to the improvement of the livestock and agricultural products through the medium of competition and the exchange of ideas amongst the various exhibitors. The first of these societies was founded at Parramatta as early as 1822 with the laudable object of "associating the members for the purpose of communicating their mutual experience and benefiting by their reciprocal advice" as well as for the improvement of the various breeds of livestock. The society also planned to carry out experiments in the growth of products which were "beyond the means of the individual purse". It started with seventy members and its early office-bearers included several of the leading graziers. For a time it wielded considerable influence and fulfilled at least some of its objectives. It was the means of introducing some new varieties of crop and pasture plants and it had a considerable effect on government policy, although its benefits to the large land-holders were more obvious than those gained by the small men. It seems to have gradually died out, leaving a comparatively disappointing record behind it in spite of its early promise. Its place was later taken by the Australian Horticultural and Agricultural Society, which was the result of the amalgamation in 1856 of two smaller associations—the Australian Botanic Society and the Horticultural Improvement Society. For a time this was a more active body and included in its membership a

larger proportion of small holders. It made a strong effort to establish an experiment farm on the domain at Parramatta, but the scheme fell through for want of popular support in spite of the encouragement of the governor, Sir William Dennison. The divergent interests of the horticulturists on the one hand and the farmers and graziers on the other, caused the agricultural section to become a separate institution. After a few ups and downs this blossomed into the Royal Agricultural Society of New South Wales which was incorporated by Act of Parliament in 1869. From the first the "Royal" was a very live and efficient organization whose activities have gained in momentum right up to the present day with a pronounced influence on the progress of all the main rural industries. Although it has many other objectives, it is best known by its great annual show where there is the keenest competition amongst the breeders of all classes of livestock and the exhibitors of agricultural produce. It has consequently been of great educational value. In the second year of its existence it staged the famous inter-colonial exhibition of 1870 which attracted competitors from all the Colonies. Keenness to win the various prizes and trophies at its annual exhibitions has encouraged breeders to import the best horses, cattle, sheep, pigs and poultry from the United Kingdom and the American continent. The influence of these importations has gradually permeated throughout nearly the whole of the livestock of Australia. Similar royal agricultural societies were gradually formed in the other Colonies with similar beneficial results. Even before the Royal Agricultural Society of New South Wales was incorporated, a number of local agricultural societies began to come into existence, the first in New South Wales being formed in the Illawarra, Goulburn and Hunter River districts. Before the end of the century it was a very small rural community indeed which did not boast such an institution. It is true that many of these local societies confined their attention to the holding of an annual show at which the ring events were the main attraction. Nevertheless, their aggregate value, especially in encouraging the improvement of the various breeds of livestock, was, and still is, very great indeed.

With regard to government technical and research aid to primary producers, we have already seen that South Australia did the pioneering work by establishing an experiment farm, and later an agricultural college, at Roseworthy in the early eighties with enormous benefit to the wheat-growers particularly. A department of agriculture was started in Sydney in 1890 and in

the following year Hawkesbury Agricultural College was established. Before the end of the century each Colony had the nucleus of an agricultural department. With regard to the agricultural colleges, Victoria went one better than South Australia and New South Wales by establishing two such institutions, one at Dookie and one at Longerenong, while Gatton Agricultural College in Queensland was founded in 1897. At these agricultural colleges successful attempts were made to educate future farmers and farmers' advisers in the fundamental principles and the most up-to-date practice of agriculture and animal husbandry.

Amongst the aims and objects of the various colonial departments of agriculture was the carrying out of experiments in field and laboratory which could form the basis of sound advice to the man on the land in his various undertakings. The greatest difficulty was finding trained staff for the investigation of soil and manurial problems, the introduction and breeding of better varieties of crops, the improvement of pastures, the combating of insect pests and diseases of plants and animals. Several notable investigators were attracted from the United Kingdom, including William Lowrie, whose work has already been described, and William Farrer, the pioneer wheat breeder of Australia. The intensive research work of the latter began before the end of the century, although the revolution in the wheat industry brought about by his new varieties did not eventuate till after the incorporation of the six States under a federal system of government.

PART II

1901-51

CHAPTER XXI

Science Takes a Hand

IN spite of the disabilities about the time of federation to which reference has already been made—a record drought and the advent of the cattle-tick and sheep blow-flies—and in spite of the occurrence of two world wars and a severe depression, the progress of the Australian rural industries has been much more rapid during the past half-century than during the previous 112 years. Much has been written about the political advantages of federation, which enabled Australia to act as a united nation in peace and in war and to speak with a single voice in international affairs. Its consummation had also a considerable effect on the progress of the land industries, as it did away with many anomalies such as interstate tariffs and customs barriers, while retaining local patriotism and the ambition of each State to compare favourably with the others. At the same time intercommunication and co-operation amongst the various States progressively improved, and knowledge derived from their combined experiences was more readily pooled.

The greatest factor in progress since the beginning of the century has been the advancement of science and its application to the problems of the primary producer. The most obvious, although not necessarily the most important, has been the greater mechanization of nearly every operation on the farm or station. Tractors of various types have largely displaced the horse teams. Improved labour-saving machinery has now been devised for the cultivation of the soil, for the seeding and harvesting of cereal crops and the subsequent handling of the grain, for the conservation of fodder, for nearly every operation on fruit and vegetable farms, as well as for the milking of cows and the manufacture of dairy products. Even the aeroplane has been called into use for the sowing of seeds and fertilizers and for the protection of crops and pastures against pests and diseases. Huge reservoirs have been, and are being, constructed along our principal rivers, thus enhancing facilities for irrigation, with the result that closely settled and highly productive rural communi-

ties have been established on land which previously carried only a few sheep. Electricity now supplied to many stations and farms provides a convenient and valuable source of power as well as a means of improving the amenities of living. Even without irrigation, much land formerly devoted to grazing has been put to the more productive use of wheat-growing and other forms of agriculture.

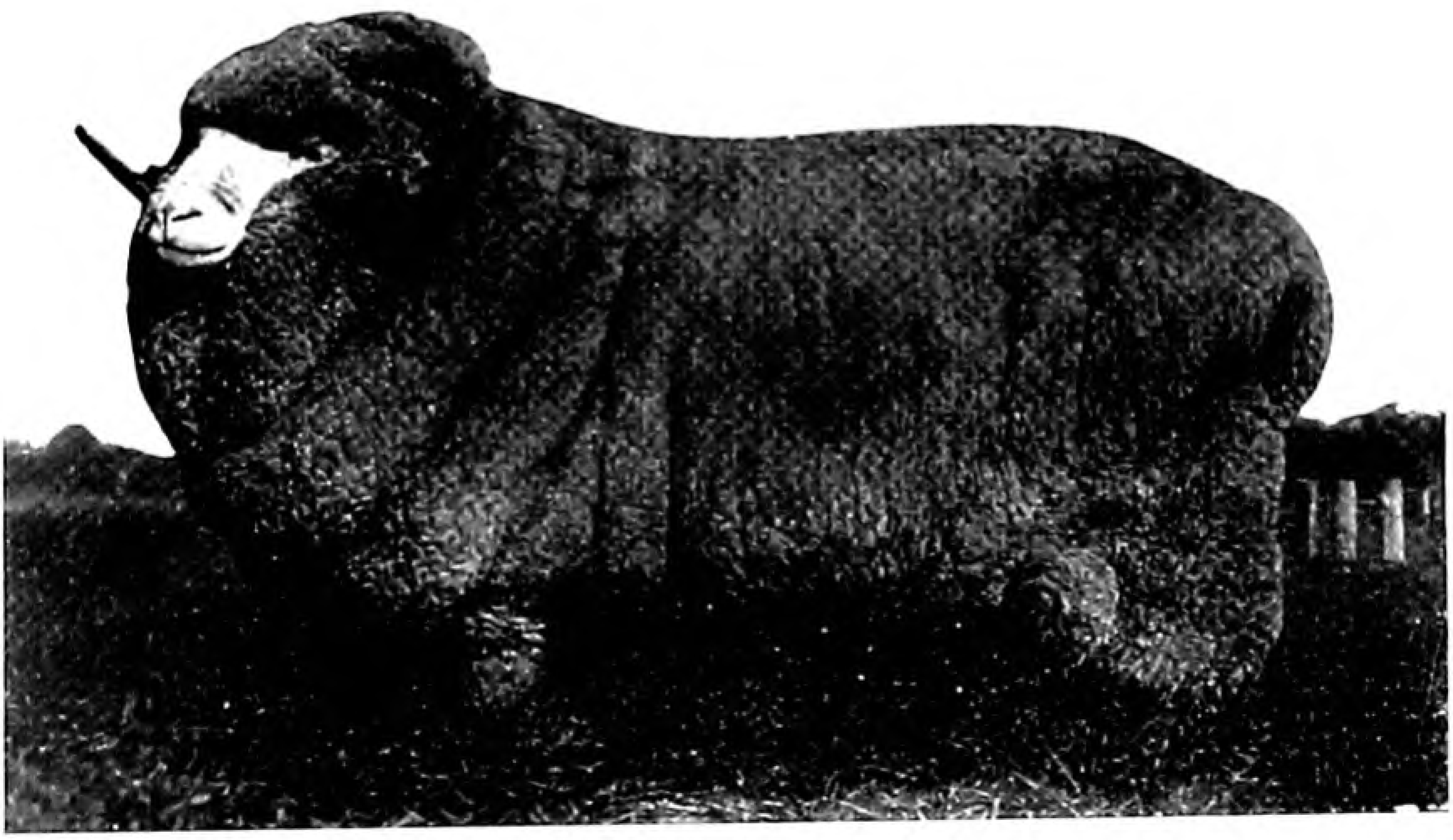
Systematic study has given us a more accurate picture of our soil and climatic resources. The best kind and quantities of the usual fertilizer ingredients have been worked out for cereals, fruits, vegetables, sugar-cane and other crops for different districts and soil types. Sensational new discoveries have led to the utilization of many soils where either plants or animals were suffering from deficiencies in minor elements like copper, cobalt, zinc, manganese and boron. Improved varieties of nearly every crop have been bred in Australia or introduced from abroad. One of the most notable advances has been in the improvement of pastures, with consequent increase in stock-carrying capacity and soil fertility, through the introduction of various species of grasses and clovers and the use of fertilizers. Several weed pests, which had reduced the production of crops and pastures, have been successfully brought under control. The tremendous annual losses through fungus and virus diseases of plants have been greatly reduced by the introduction of new fungicides and the breeding of disease-resistant varieties. Many insect pests which had taken a disastrous annual toll, especially in orchards and vegetable gardens, have been greatly lessened and sometimes eliminated by twentieth century methods. Hormones have been discovered which have such varied functions as the selective destruction of noxious weeds, the prevention of the premature falling of fruits and ensuring the more certain and rapid rooting of cuttings. The introduction of a virus disease is helping to solve the rabbit problem.

Effective quarantine regulations have continued to keep out of Australia some of the most dreaded diseases of livestock, whilst others already in the country have been efficiently controlled as knowledge of them has grown and new methods of treatment have been devised by trained veterinarians. New commercial crops have been introduced and the best techniques for their successful growth under Australian conditions gradually discovered and put into practice. Up-to-date means of processing fruits and vegetables have been devised and improvements in cold storage methods introduced as the result of scientific research

MILDURA VINEYARD

EARLY MERINO RAM

Weight of fleece about five pounds.



MODERN MERINO RAM

Weight of fleece $41\frac{1}{4}$ pounds.

here and abroad. The advancement of science has brought an immense improvement in the quality of our butter and a greater variety of products and by-products of the dairying industry, including fancy cheeses, casein, dried and condensed milk and ice-cream.

On the other side of the picture has to be noted the havoc wrought in many districts by soil erosion, in some cases almost unavoidable, but in others due to unwise treatment of the land by over-clearing, over-stocking and over-cropping. It took Australia much too long a time to realize the danger, but it is comforting to know that active steps are now being taken in all States to minimize the damage. It is rather disappointing that there is still insufficient initiative (sometimes insufficient capital) on the part of some of our land-holders to take full advantage of the progress made by scientific investigation. A notable example is the failure of so many stock-owners to conserve anything like an adequate amount of fodder and water to see them through a drought or even a comparatively short dry spell.

The shortage of trained investigators has been largely met by the establishment of schools of agriculture and of veterinary science in the universities, while technical and advisory officers have become more plentiful by the progressive development of our agricultural colleges. State agricultural departments have become better staffed and their investigation work at experiment farms and laboratories raised to a higher plane. More competent men have become available for carrying out extension and advisory work amongst the farmers themselves with the co-operation and assistance of agricultural bureaux and other farmers' organizations. Agricultural education has become available to boys of school age who might never have the opportunity of attending an agricultural college. Boys' agricultural clubs and junior farmers' clubs have sprung up all over the continent with great promise for the future. Agricultural research stations have been established in every State, sometimes as the result of private benefactions from public-spirited citizens. The Commonwealth government itself has entered the field of agricultural and veterinary research, partly with the idea of tackling big national problems with which individual States had not the resources to deal and partly to participate in and standardize investigations carried on by more than one State. As in every progressive country in the world, agricultural education and research have made an inestimable contribution to the general progress of the rural industries.

Australia could not hope to keep on importing a sufficient number of qualified agricultural scientists like Lowrie in South Australia, Farrer in New South Wales and McAlpine in Victoria, and men with progressive ideas therefore began to advocate the training of Australian research workers, senior extension officers and administrators in our own universities. The first attempts were made in South Australia and Victoria to achieve the object by combining work in the science faculties at the universities with practical instruction at agricultural colleges, but the result was not satisfactory and very few students were attracted. It became obvious that the real need was for a chair of agriculture in each university, the occupant of which could plan a co-ordinated curriculum and see that the instruction was properly given. Melbourne was the first university to appoint a professor of veterinary science, although the chair was subsequently abandoned, as it was considered that the Sydney school, established in 1909, could supply the needs of Australia for some time to come. The first chair of agriculture in Australia was established at the University of Sydney in 1910 out of the same vote as that which catered for veterinary science. The early students were mainly cadets or trainees nominated by the State department of agriculture; they were given free tuition at the university, provided that they signed a bond to serve the department for a period of five years after graduation. The first of them had just obtained their degrees when the first war with Germany broke out and the majority of the agricultural graduates and students of military age volunteered for active service. The building of the school of agriculture at the University of Sydney was completed in 1916, but it was not adequately equipped till a few years later. It was not till 1920 that any very marked progress was made. Returning undergraduates helped to swell the number of students, and the early graduates, after very distinguished war records, had at last an opportunity of showing what they could do in civil occupations. In that year agriculture, which had previously been attached to the faculty of science, was raised to the status of a separate faculty and its progress has been rapid and continuous ever since.

Melbourne followed with a chair of agriculture a year later than Sydney and its early activities were even more restricted during the war period, when Professor Cherry himself was seconded for war service abroad in his capacity as a doctor of medicine. It revived in the early twenties under the guidance of Dr A. E. V. Richardson, when provision was made for the

erection of a building, and a scheme similar to the New South Wales arrangement for cadetships was instituted. Since that time its progress has been similar to that in Sydney. Western Australia was enabled to follow the example of Sydney and Melbourne through the Hackett bequest, which resulted in the appointment of a professor of agriculture in 1914, and the progress of the faculty of agriculture there has been very creditable, considering the comparatively small population of the State at the time of its initiation. A recent development there has been the establishment in 1938 of an institute of agriculture within the university grounds for the prosecution of research, financed partly by the university and partly by the State government.

In Adelaide little progress was made with agricultural education at the tertiary level until a magnificent series of bequests placed the university on a much better footing in regard to research than all the other faculties of agriculture in Australia put together, through the founding of the Waite Institute. The original benefactor, after whom the institute was named, was the late Peter Waite, who left the University of Adelaide a considerable area of land at Glen Osmond together with a large monetary endowment for the building of a laboratory for agricultural research. Operations began in 1925 under the direction of the late Dr A. E. V. Richardson, and other munificent gifts followed from Sir John Melrose, the John Darling family and the Ransom Mortlock family. With these resources, well-trained groups of workers have engaged in research into a great variety of problems connected with soils, pastures, crop rotations, climatology, cereal breeding, plant pathology and entomology with great benefit to South Australia and the Commonwealth. No degree in agricultural science was available in Queensland till 1927, when the principal of Gatton Agricultural College was given the additional post of professor of agriculture in the university. All the universities on the mainland have now well-developed faculties of agriculture and amongst them are suceeding in supplying the main requirements for teaching, research and administrative positions in State government departments and institutions as well as Commonwealth organizations, with a surplus of technical men for industries connected with agriculture or the treatment of agricultural products. In spite of the limited amount of spare time available, extremely valuable research work is, in addition, being carried out by the teaching staffs of all the universities, frequently with the assistance of senior students.

In 1916 the prime minister, W. M. Hughes, was so impressed by the success that had attended the efforts of Germany in peace and in war through the application of science, that he called together a number of men prominent in science and industry to advise him as to what could be done along similar lines in Australia. As a result of this meeting an honorary advisory council of science and industry was set up, with an executive which met in Melbourne with Sir David Orme Masson as chairman and a State committee in each of the States. After much discussion it was decided to concentrate on a few problems of the primary industries which were of national importance—soil surveys, cattle-ticks, sheep blow-flies, the prickly pear pest and forest products. Some progress was made during the short régime of the advisory council with the first three, and it is to the lasting credit of this honorary body that it set in motion the agencies which were finally successful in eradicating the worst weed pest that ever gained a footing in Australia, and started the investigations which led to the successful utilization of hardwood pulp in paper-making. In 1919 Dr Gellatly was appointed full-time director and things went on very much as before, as he wisely retained the services of the executive committee and the State committees of the advistory council which had been carrying on such fine work. After his sudden death Sir George Knibbs, who had been a very efficient Government statistician, was appointed director of what was now called the institute of science and industry. He gathered round him a small administrative and technical staff and decided to dispense with the services of his honorary committees. As Sir George was getting on in years and unable to travel extensively, this proved a mistaken policy and progress was comparatively slow. It was during the régime of the "Institute", however, that the banana industry was saved from extinction by a puzzling disease and that considerable progress was made with forest product researches. After the passing of Sir George, a complete reorganization took place in 1926 along the lines suggested by the original advisory council supported by Sir Frank Heath, who had been brought from England by the prime minister, S. M. Bruce, to report on the whole subject. The council of scientific and industrial research (C.S.I.R.) was set up, which met at least twice a year to plan the general policy. The carrying out of the policy, and a great deal of the policy-making as well, was in the hands of a paid executive of which Sir George Julius was chairman, and Professor Rivett (afterwards Sir David Rivett) chief executive officer. With larger

funds available it was able to enter on a much more ambitious research programme. For some years it was principally concerned with problems of the primary industries and it gradually built up regular divisions of animal health and nutrition, soils, plant industry, entomology, food preservation and transport and forest products, each under its own chief. In later years an increasing amount of research has been devoted to problems of the secondary industries, especially those which have a bearing on defence.

There was some danger that this re-organized Commonwealth council might overlap with the activities of State departments of agriculture. In order to avoid this, a standing committee on agriculture was set up, consisting of the members of the executive of C.S.I.R. and the heads of the various State agricultural departments. This committee met once or twice a year to discuss primary industry problems and define the respective spheres of each organization as far as research was concerned. The general plan was for C.S.I.R. to concentrate largely on fundamental research and for the more applied problems to be shared, whilst the State agricultural departments would be responsible for all the extension work amongst the farmers. The system on the whole has worked out smoothly and there have been many examples of co-operative efforts which have been very successful. The designation has recently been changed to Commonwealth scientific and industrial research organization (C.S.I.R.O.).

In order to deal with some administrative problems which occurred during the 1939-45 war, it was found necessary to set up a Commonwealth department of commerce and agriculture. This was not at first concerned with research, but as an adjunct to it has arisen the bureau of agricultural economics, which is actively engaged in research in this hitherto neglected field.

It is rather unusual in Australia to find a research institution supported, or largely supported, by a particular primary industry, but this is true of the bureau of sugar experiment stations in Queensland, which for administrative purposes, is directly associated with the department of agriculture and stock. It is now under a board consisting of two industry representatives (one a grower) and two government representatives, one of whom is chairman; this change occurred on 1st July 1951. It was founded about the time of federation to investigate problems occurring in every phase of the sugar industry, and its various scientists and technicians carry out research work in the laboratory, the

field and the mill which has been of enormous value to the industry.

Speaking generally, the facilities available for agricultural research were almost negligible at the time of federation and advanced slowly until about 1926. Since then progress has been much more rapid, although expenditure on it is still a long way behind that of the United States, Canada, Denmark, New Zealand and South Africa, whether measured on the basis of population or production. Some of the agricultural research work carried out in Australia has led to spectacular results, a few examples of which will be mentioned later, but much of it has consisted of slow methodical additions to knowledge which have passed almost imperceptibly into farming practice.

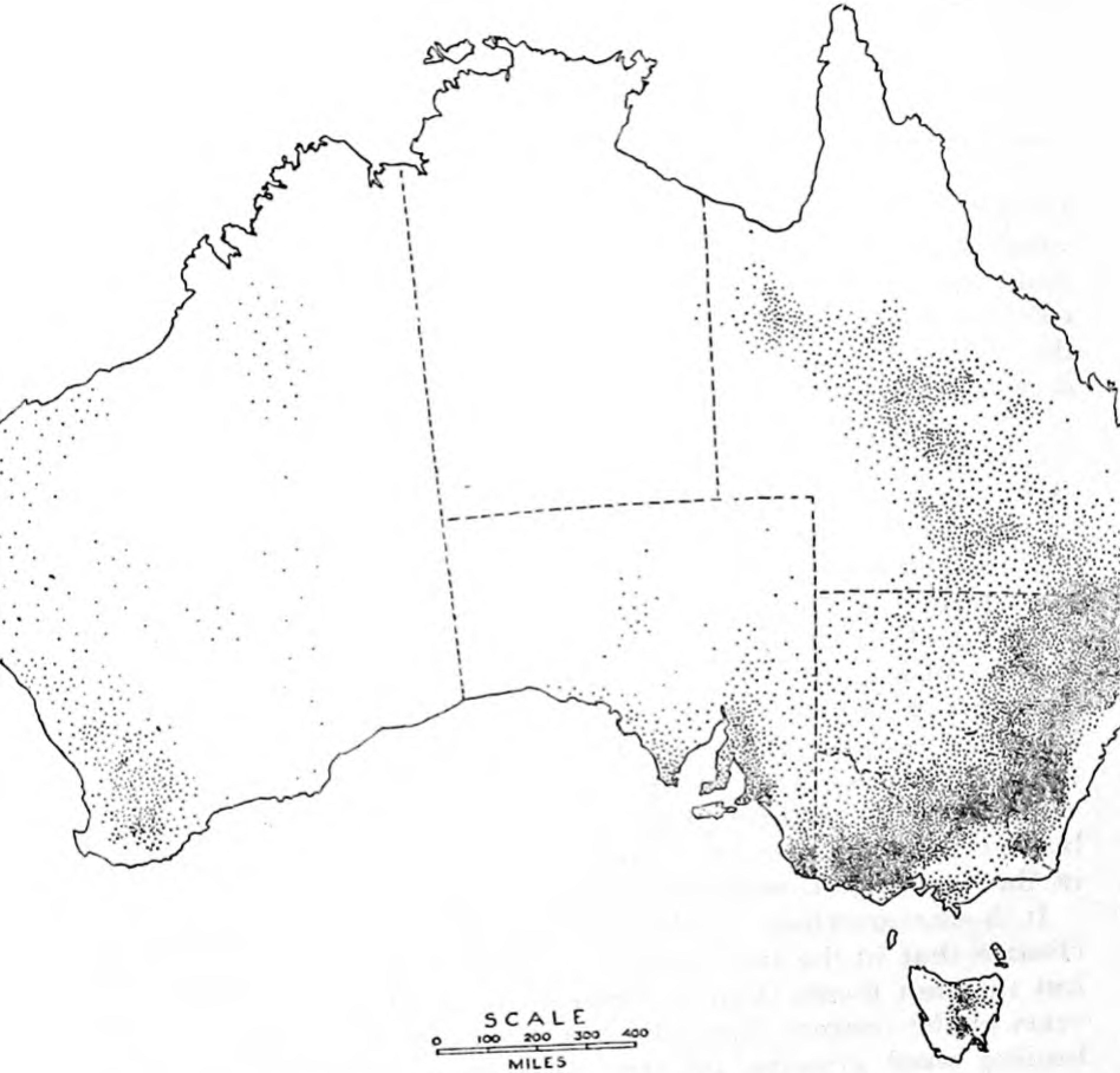
CHAPTER XXII

The Sheep and Wool Industry in the Twentieth Century

In spite of the rapid advances in agriculture and dairying, the wool industry after federation continued to be the mainstay of Australia's economy. The beginning of the new century coincided with the most acute, widespread and disastrous drought in the history of the country. The numbers of sheep had already dropped from 106 million to seventy million during the dry period preceding federation. In 1902, when the drought reached its maximum intensity, there was a further fall to 56 million as the result of deaths through starvation and thirst and failure of increase. The graziers took their losses philosophically, and when the drought broke in the following year, the great recuperative power of the pastoral country was shown. From 1903 the numbers of sheep increased steadily until the 100 million mark was reached again in 1911. There was again a recession through droughts of varying range and intensity in 1912, 1914, and 1919-20. Since 1925 the numbers of sheep in Australia have exceeded 100 million each year except for another dry period in 1944-6, when they fell slightly below that figure. The maximum number recorded for any one year was 125 million in 1941-2, whilst in the year 1950-1, some 115 million were pastured.

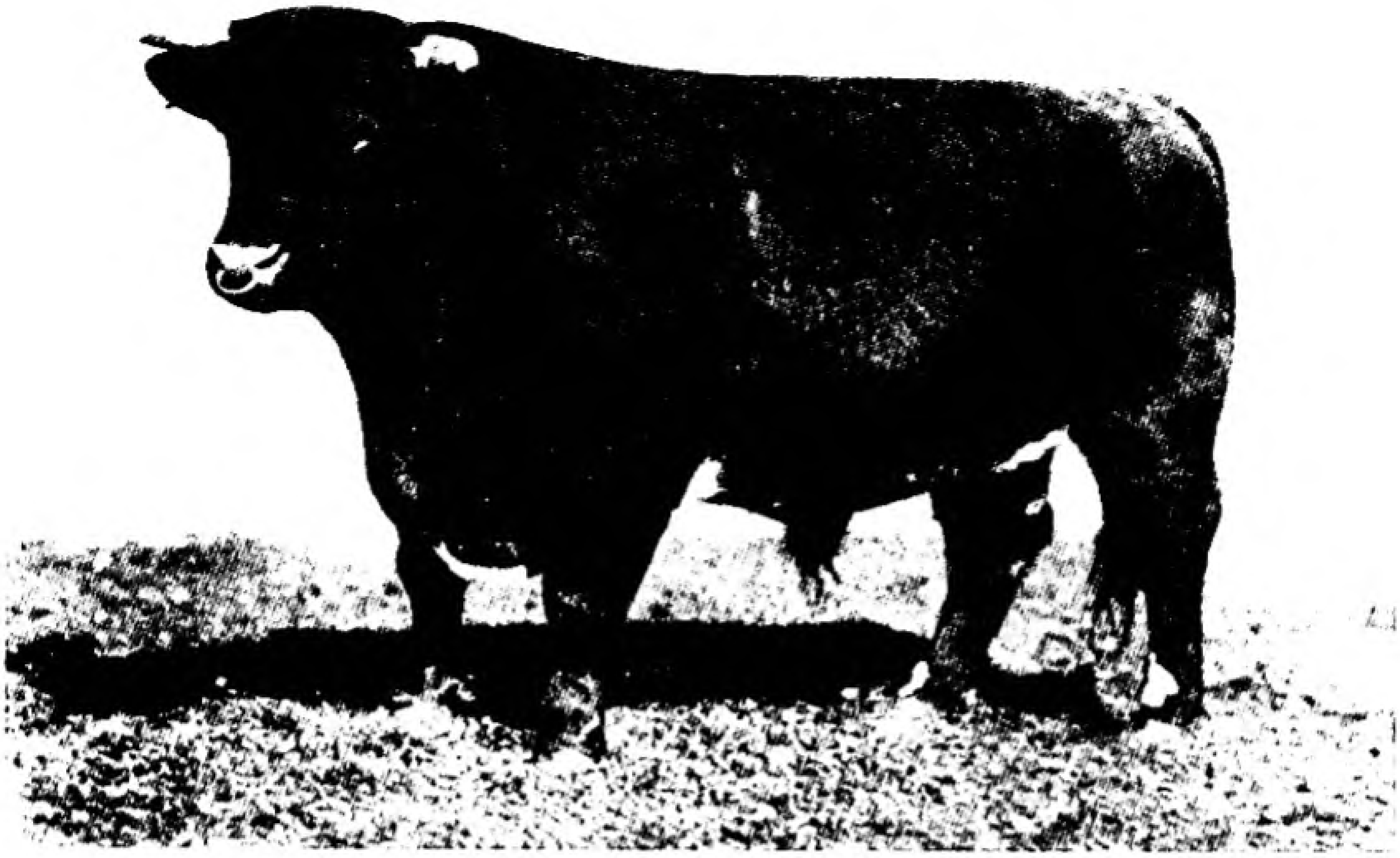
It is characteristic of the variable nature of the Australian climate that in the last two years of the period more sheep were lost through floods than through droughts. During the first fifty years of the century Australia has maintained its position as the leading wool growing country with about one-sixth of all the sheep in the world, and twice as many as the United States or U.S.S.R., which generally came next on the list as far as the sheep population is concerned.

It is pleasing to note the relative steadiness of the numbers during the last quarter of a century, which is a reflection of improvements in technique. It is true that there have been no droughts so general or prolonged as the great drought of 1902,



DISTRIBUTION OF SHEEP IN AUSTRALIA

Each dot represents 20,000 sheep.



MASTERKEY

An imported beef Shorthorn bull whose influence on the improvement of the breed along modern lines was probably greater than any other.

MELBA XV OF DARBALARA

World champion dairy cow for several years.

WILLIAM FARRER

Pioneer wheat-breeder.

but there have been many of marked intensity and some of considerable duration, although not so widespread. With a better understanding of the country there has been less general over-stocking and a more adequate provision for the water requirements of the flocks. Much more attention has also been given to the control of diseases and of internal and external parasites, while in the better rainfall districts, pasture improvement and a certain amount of fodder conservation have added greatly to the stock-carrying capacity. In all of these respects there is still room for improvement.

More creditable than this steadiness in numbers has been the continued improvement in the yield of wool per sheep. As in the period before federation, this has been largely due to the work of our great stud-breeders, whose high-producing rams have gradually spread their influence through the majority of the flocks of the Commonwealth. These stud-breeders and their advisers have been so numerous that it would be invidious to mention names, but the greatest single factor which has influenced the flocks as a whole has been the Peppin or Wanganella strain, with their large well-covered frames with prominent neck-folds but freedom from body wrinkles. It is unfair to take the figures for any single year, as they are affected by the general nature of the season, but for the five years up to and including 1901 the average weight of fleece was 6.29 lb., whereas the average for the five seasons 1945-6 to 1949-50 was 9.45 lb., or an increase of fifty per cent.

The value of the sheep industry to the individual pastoralist, as well as to the nation, depends as much on the price of wool as on the actual amount produced. Over the period under review this has fluctuated much more than the numbers of sheep. At the beginning of the century, Australia was able to compete successfully in the world's markets largely on account of the low cost of production of high quality wool. The price paid for the land had usually been very small, and many of the large flocks were mustered only once a year for the shearing, which was done very rapidly in large shearing-sheds equipped with the most up-to-date machinery in the world at the time. It was done by itinerant shearers, and the classing of the wool was performed with reasonable efficiency by men who did not claim a high rate of remuneration. From 1903 to 1914 the industry was quite profitable, with an average selling price of under ninepence per lb. During the later years of the war period, the British government acquired the whole Australian clip at an average price of 1s. 3½d.

per lb. Although cost of production had increased considerably, the industry continued to prosper in the decade following the first world war with an average sale value of about 1s. 6d. per lb. Then came the depression years, when only those who displayed efficient management and had sufficient reserves behind them were able to make any progress at all. The cost of production at this period was calculated to be about one shilling per lb. and the average price obtained for the decade preceding the second world war was only 11½d. It fell as low as 8.72d. per lb. in 1932-3, but revived to 15.84d. per lb. in the following year, and fell again to 10.39d. per lb. in 1938-9. During the second world war a contract was again made with the British government at a price of 13.44d. per lb. for the first two years, and 15.45d. for the last three years. These prices returned only a small margin of profit to the average producer of wool and there was considerable relief when a return was made to sales by auction, with representatives of all leading manufacturing nations again competing for the clip. During each world war there was a big accumulation of wool, but in each case an organization was formed which wisely released the surplus to the market by gradual stages after peace was declared. The result in each case was that a very satisfactory price was obtained for several years after each war. Indeed, since the second world war the rise has been quite sensational; almost embarrassing. The prices in the last five years have averaged two shillings, 3s. 3½d., four shillings, 5s. 3d. and 12s. 1d. per lb. respectively.

The amount of Australia's annual wool cheque, which was as low as £27 million in 1930-1, £39 million in 1938-9 and £60-£70 million during the war period, rose to £287 million in 1949-50 and to the colossal sum of £636 million in 1950-1. This last figure represents an average value per fleece of £5 12s. and is equivalent to nearly £80 per head of human population.

The average of 12s. 1d. per lb., or £5 12s. per fleece, is all the more remarkable since it includes the produce of both sexes, all breeds and all ages. The price paid at auction for the very finest merino wool seldom exceeded four shillings per pound before the last two or three years. In 1950-1 the record price paid for fleece wool was no less than 29s. 6d. per lb, while a small consignment of lamb's wool sold at the rate of 35s. 7d. per lb. A shortage in world production during the war and increased demand since then help to account for these figures, which are phenomenal even when the fall in the value of the pound sterling and of the Australian pound is taken into consideration.

An unfortunate result has been the diversion of the energies of those who could make the change from the growth of wheat and other food stuffs to wool production.

One major change in the sheep and wool industry which has taken place since the beginning of the century has been the growth in importance of breeds other than the pure merino, the proportion of the latter falling from about 95 per cent in 1900 to 82 per cent in 1950. Whatever trend future wool prices may take, there will always be an important place in Australia for the pure merino, especially in the drier and more elevated or less accessible districts not suitable for agriculture or intensive grazing. An insistent demand, however, arose early in the century for another type of sheep owing to the subdivision of large estates and the advancement of agriculture. As the flocks were reduced in numbers it became essential to obtain a larger profit per sheep than was available before the sensational rise in the price of wool. It has already been noted that the merino has been specialized as a wool-producing machine, rather deficient in mutton qualities. For the larger profit necessitated by the smaller area of individual holdings, it was necessary to have dual-purpose sheep for the production of mutton as well as wool, and especially for the fat-lamb trade for both local consumption and export. This led to the introduction of several British breeds renowned for their mutton-producing qualities and early maturity to cross with the merino. If one were thinking of fat lamb and mutton alone one might leave the merino out of the picture altogether, as is almost invariably done in New Zealand. Owing to the abundance of merino ewes in Australia and the high value of the wool of its crosses, it seems probable that for a long time some merino blood must enter into the composition of the dual-purpose sheep and lamb here. The selection of the best British breed to cross with the merino might seem a comparatively simple matter, but it is not quite so easy when it is known that about forty different breeds of sheep have been evolved in the United Kingdom, each suitable to particular districts and different sets of conditions. They may be subdivided first of all into the mountain breeds and the lowland breeds and the latter again into the long-wool and short-wool breeds. With the possible exception of the Cheviot, the mountain breeds may be ruled out of consideration. That narrows down the choice to the long-wools and the short-wools. The former are characterized by their large size, their white faces, the absence of horns and by a profusion of rather coarse long wool. As a class,

they might be described as dual-purpose sheep. The short-wools have shorter legs and a more compact frame with short wool of rather poor quality, and are generally regarded as pure mutton types. They include a number of breeds known as Down breeds—the Southdown, Shropshire Down, Suffolk Down, etc.—all characterized by coloured faces ranging from grey to black. One unfortunate feature of all the Down breeds is the frequent occurrence of black fibres amongst the white, which decreases the selling value of the wool. There are, however, two British short-wool breeds with white faces which are free from this objectionable feature, namely the Dorset Horn and the Ryeland. In most other respects they are similar to the Down breeds and, although of only local importance in England, they have attracted more attention in Australia because of this freedom from coloured fibres in their wool.

Of the many long-wool British breeds the three most prominent are the Lincoln, the Leicester (known in Australia as the English Leicester) and the Border Leicester. The Lincoln is the largest of the three, with very long and rather coarse wool with a well-marked lustre. It was the first of the British breeds to be introduced into Australia and was very popular for crossing with the merino, as the progeny of the cross gave a much larger carcass and a type of wool which was long in the staple and intermediate in fineness and crimp between that of the two parents.

The two Leicester breeds were evolved in England from the Lincoln by noted breeders who aimed at producing an earlier maturing animal with a neater and more compact carcass. They are really an improvement on the Lincoln from the point of view of remedying the defects of the merino. The wool is not quite as long and is rather finer in texture, so that the blend in the Leicester-merino crossbred is even more attractive. The border Leicester has proved the hardier of the two under Australian conditions and is now easily the most popular of all the long-wool breeds, especially in the relatively dry regions. Another advantage is that it has a narrow face and forehead and consequently does not give rise to the parturition difficulties which are sometimes encountered when the English Leicester ram is mated with the smaller merino ewe. There is a fourth long-wool breed with only a limited habitat in England which has become very popular in Australia and New Zealand, namely the Romney or Romney Marsh. In England it is almost entirely confined to marshy country on the banks of the Thames, where, by the survival of the fittest, it has become noted for its resistance

to foot-rot, liver fluke and other troubles associated with a humid climate and a wet soil. It consequently has become very popular in the moister parts of the coastal and tableland districts of Australia, where it and its crosses are almost exclusively used. The wool is rather shorter than in the other long-wools, more erect and not in such distinct locks, and it, too, blends reasonably well with the merino.

Even the best of the long-wools are not of such a pronounced mutton type as the short-wools, and the first cross with even the border Leicester does not suit the British fat-lamb market so well as that in which one of the short-wools is used as the male parent. The Southdown cross actually suits the British market best and the reputation of Canterbury lamb from New Zealand has largely been built up on a mating of the Southdown ram with the Romney ewe. For reasons already mentioned, the Dorset Horn and the Ryeland are frequently substituted for it in Australia. When a short-wool ram is used for fat-lamb production in the Commonwealth, it has become increasingly common to use a long-wool merino cross as the mother instead of the pure merino on account of its roomier frame and higher yield of milk. Experts in the fat-lamb industry may thus use Southdown, Dorset Horn or Ryeland rams and Border Leicester merino cross ewes. Other Down breeds, like the Shropshire Down, the Suffolk Down and the Dorset Down, are used to a limited extent in districts or sets of conditions which particularly suit them.

The increasing use of these British breeds has made possible the rapid development of the fat-lamb industry, especially in conjunction with cereal-growing and where pasture improvement is practised. Considerable areas, especially in Victoria, are devoted to fat-lamb raising on irrigated pastures. In 1900-1, the export of mutton and lamb was 91 million lb., whilst by 1942-3, in spite of greatly increased local consumption, it had attained the record figure up to that time of 204 million lb. valued at about £5½ million. It is noteworthy, too, that whereas the exports at the beginning of the century largely consisted of mutton of rather poor quality, about eighty per cent of the exports of recent years have been good quality lamb.

The long-wool merino cross is a very useful dual-purpose sheep with much better mutton qualities than the pure merino and a larger clip of wool of quite good quality, although not nearly so valuable as that of the pure merino, especially at the present time. It involves keeping up a supply of good long-wool rams, and there may be difficulty in disposing of the male progeny of

the cross at a profit if they cannot be sold as fat lambs. It would obviously be a great advantage if a breed could be evolved possessing all the good points of the long-wool merino cross which could be fixed and would breed true. This idea occurred to a number of shrewd breeders in both New Zealand and Australia, and they set about crossing a long-wool (chiefly the Lincoln) with the merino and mating the cross-bred progeny with others of similar breeding. By continuing this practice over a number of generations with liberal culling to the desired type, they have evolved an entirely new breed of sheep, called the Corriedale, which has gained rapidly in popularity of recent years, not only in Australia, but in other countries with somewhat similar climatic conditions. It might be regarded as a fixed long-wool-merino crossbred.

Another useful type of sheep derived from the merino is the comeback. It is the result of mating a long-wool merino crossbred ewe with a merino ram. The result is a sheep with a larger frame and longer wool, while the quality of the wool is little inferior to that of the pure merino. It will be obvious that the production of a flock of comebacks involves a somewhat complicated breeding programme. Again it would be a great advantage if a pure breed of the comeback type could be evolved which would breed true. Such a breed, which might be classed as a fixed comeback, has actually been produced in Victoria by mating comebacks with each other over a series of generations and again culling to type. This new breed, the Polwarth, has become very popular in Victoria, and its use is gradually spreading to the other States of the Commonwealth.

The production of these two new breeds, together with the improvement in their uniformity and valuable characteristics, is a creditable achievement on the part of those who were responsible for their evolution and subsequent development.

The advancement of science during the last half-century has been of immense value to the pastoral industry. In the more reliable rainfall districts the improvement of pastures by the use of fertilizers and the introduction of new grasses and clovers has greatly increased the carrying capacity. In southern Australia the combination of subterranean clover and the application of superphosphate on numerous farms and stations has worked wonders. On one property in New South Wales, for instance, the carrying capacity has been trebled, the wool production quadrupled and soil erosion completely arrested by this means. In other cases the use of very small quantities of trace elements

like copper cobalt, zinc and molybdenum or a combination of two of them together with superphosphate, has transformed practically useless land into highly productive areas carrying healthy stock. Poisonous plants have been definitely identified and the destruction of other noxious weeds economically carried out by the use of hormone sprays. Much has been done to reduce the losses caused by two of the greatest enemies of the pastoral industry—rabbits and blow-flies. Although only effective where the vectors are present—mosquitoes, sand-flies, etc.—an introduced virus has brought about the death of millions of rabbits by myxomatosis. From 1903 onwards the ravages caused by the sheep blow-fly increased in extent and virulence to an alarming extent. Investigation has thrown much light on the species involved, their life histories and the circumstances which attract them to the sheep. Crutching and a modified Mules operation, which removes the wrinkles from the posterior of the sheep, are almost complete answers to crutch strike, and spraying and swabbing with the new insecticides, D.D.T. and B.H.C., appear to be effective in dealing with body strike. Careful studies of the life history of the organisms responsible for liver fluke, black disease and foot-rot have enabled pastoralists in the moister districts and seasons to gain reasonable control of these serious pests. Proper attention to hygienic methods in and around the shearing-sheds have greatly lessened the dangers from tetanus and caseous lymphadenitis. A study of the life history of stomach and intestinal worms, which cause huge economic losses, has enabled recommendations to be made regarding the drenching of sheep with the new anthelmintics like phenothiazine with very successful results. The importance of satisfactory nutrition as a palliative has also been emphasized.

Improved dipping methods have helped in the battle against external parasites like keds and lice. Preventive inoculation has proved successful in dealing with several diseases, and studies on the causes of infertility in rams have thrown light on breeding problems. Improved machinery, like the pick-up baler, has helped to make fodder conservation on many properties a more practical proposition, and in many other ways the service of science to the pastoral industry is continually extending.

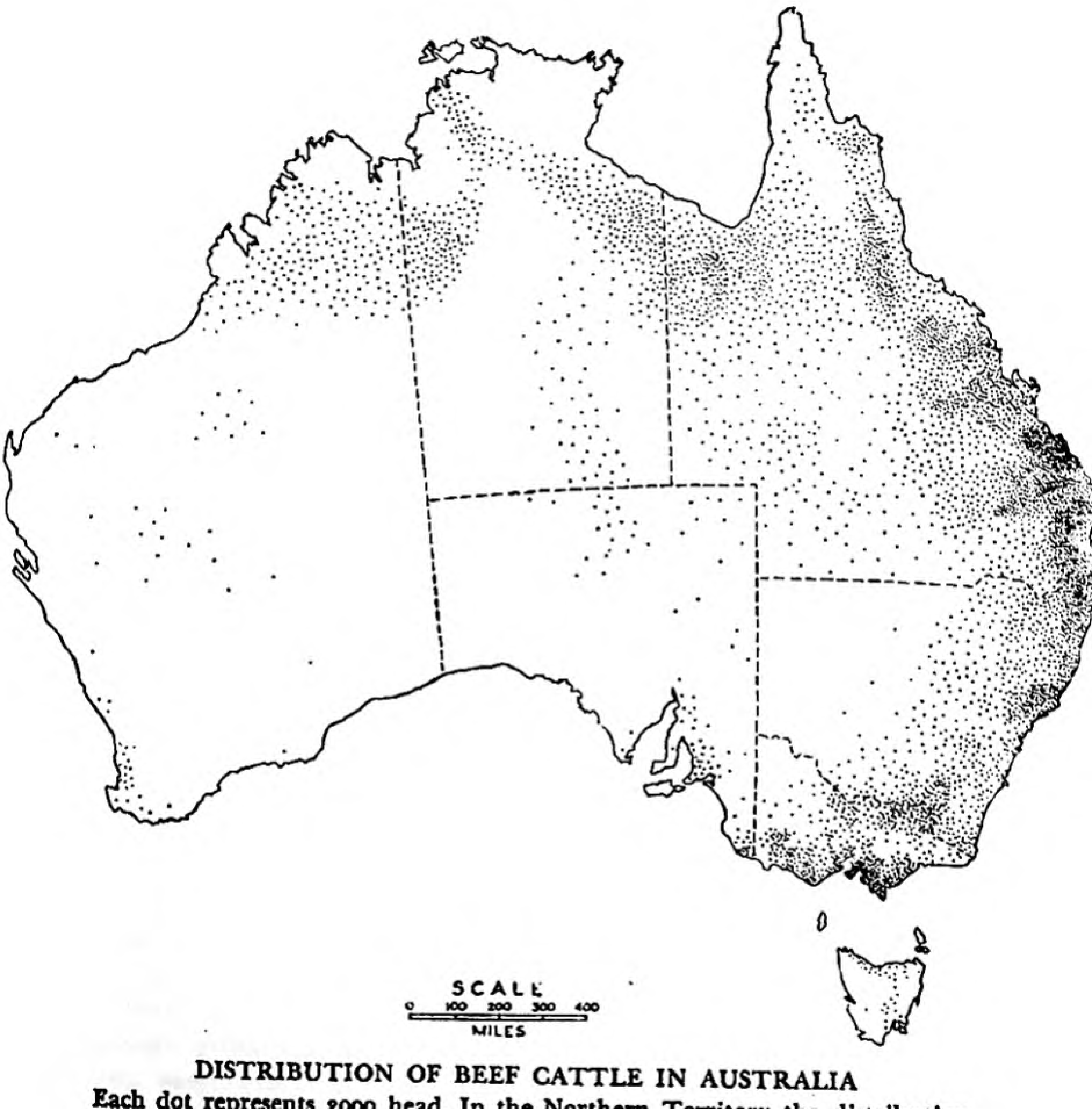
CHAPTER XXIII

The Beef-cattle Industry Since Federation

As already noted, the number of cattle in Australia declined from twelve million in 1894 to 8.6 million in 1901. The severe drought and the ravages of tick fever caused a further fall to seven million by the end of 1902. After that there was a fairly steady and rapid increase up to 1921, when the maximum number up to that period of 14,441,000 was attained. Then there was a slight drop owing to the falling off in demand for frozen meat in the next eight years. The fourteen million mark was regained by 1934 and the fifteen million mark has recently been passed. These figures include dairy cattle as well as beef cattle, and as there has been, a steady increase in the former, the numbers of beef cattle have declined slightly in recent years to under nine million, with an annual slaughtering of about three million. Australia usually comes ninth or tenth as far as cattle numbers are concerned, having fewer than India, the United States, U.S.S.R., Brazil, the Argentine, China, France and Germany, usually in that order.

In the immediate pre-war period (1936-9) the annual production of beef and veal was 569,000 tons, of which 127,000 tons were exported. The beef available for home consumption was therefore 442,000 tons, which is equivalent to 144 lb. per head of population—probably the highest figure for any country in the world. The consumption per head diminished rapidly during the war period, especially after rationing was introduced in 1944, when it fell to about ninety lb. It has increased since 1946, but has never approached the pre-war figure, largely due to the substantial rise in price. The increase in Australia's population has left less meat available for export than in pre-war days. This is most unfortunate, owing to the desirability, indeed the necessity, to send more beef to meat-starved Britain. Thus in 1938-9 the total exports of beef and veal amounted to 272 million lb., valued at £4,324,000, whilst in 1947-8 the corresponding figures were 234.6 million lb. and £6 million, and they have declined considerably since then.

Before the second world war a moderate portion of our exports



DISTRIBUTION OF BEEF CATTLE IN AUSTRALIA
Each dot represents 2000 head. In the Northern Territory the distribution is approximate only.

went to countries like Egypt, Malta, Malaya, the Philippine Islands and Hong Kong. In 1944 the British government entered into a contract to purchase the whole of Australia's surplus till 1948, and this was afterwards extended to 30th September 1950. Since then an amended contract has been signed for the next fifteen years, one of the conditions being that strenuous efforts should be made to increase the exportable surplus. Floods in many districts, followed by droughts and bush fires, together with the high price of wool, unfortunately have militated against the achievement of this desirable end for the present.

Australia's great rival in the British market for beef is the Argentine republic, which has several advantages over Australia in possessing a large area of fertile, good rainfall country suitable for beef production conveniently situated for transport to the coast, and a much shorter sea voyage for the cargo. The latter advantage enables her to send beef in the chilled state instead of the less attractive frozen carcasses, and Argentine chilled beef in the British market has usually brought about double the price offered for frozen beef from Australia. A fine piece of co-operative research between officers of the C.S.I.R.O. in Australia and the low temperature research station at Cambridge University resulted in devising a technique which made possible the successful transference to London of chilled beef from Australia and even New Zealand. Trial shipments of 234,000 lb. were made in 1932-3 and the quantity of chilled beef exported from Australia gradually rose to nearly sixty million lb. in 1938-9, valued at about £1 million.

The uncertainty of the shipping position during the war unfortunately brought this promising trade to an abrupt conclusion, and it is only quite recently that it has been resumed. The advantage of chilled beef over frozen is not the only reason for the higher price paid to the Argentine producers, as the bulk of their exports consisted of younger, better quality carcasses than the majority sent from Australia. Indeed, it is hardly worth while adopting the chilling process for anything other than the product of early maturing cattle which have put on weight continuously from birth and have not had to travel far for food and water. The advent of chilling thus had a beneficial effect on the owners of cattle in the more favoured districts, and they have paid more attention to such desirable features as better breeding, feeding and handling. Pasture improvement, fodder conservation and the provision of an adequate water supply have received more attention, and it is to be hoped that this

progress will continue and intensify now that Australian chilled beef has attained recognition on the British market.

It is difficult to generalize about the Australian beef-cattle industry as the conditions under which it is practised vary so greatly. It is a first-class proposition in the more favoured districts of Tasmania, Victoria, New South Wales and southern Queensland, where the rainfall is reasonably adequate and good grazing can be relied upon through the greater part of the year. It adds greatly to the value of a property in these areas if it includes some river flats where lucerne can be grown even without irrigation. It is in such locations that the majority of the stud-farms are situated, and here, too, it is easy to produce the baby beef which is so much sought after by discriminating purchasers on the local market and by exporters of chilled beef.

It is a second-class proposition in the drier areas of Victoria and New South Wales and in the central and north coast regions of Queensland. Here, owing to prolonged dry spells, the plane of nutrition throughout the year is not so uniform, and the bullocks may require an extra year before they are ready for slaughter. Having to travel farther for their food and water, they do not produce the tender meat that can be expected from the first class. Especially in the southern States, cattle-raising is frequently combined with other industries, and here, too, the quantity and quality of the final product could frequently be improved by more attention to the growth of crops for supplementary feeding and the conserving of the excessive growth of pastures in good seasons.

It is a third-class proposition in the tropical north of Western Australia, the Northern Territory, and of Queensland west of the Great Dividing Range. This covers very much the largest area of cattle country in Australia, but its carrying capacity is low, so that the numbers bred and pastured there constitute less than a sixth of the total cattle population of Australia. Since the human population is also very low, it is one of the main sources of beef for export. It is a region with a short period of summer rainfall and a long winter and spring drought, so that the beef-cattle industry is almost the only possible means of utilizing the land extensively. Although the rainfall may vary from fifteen up to forty inches, it generally comes in a few heavy falls, much of which runs off the surface and tends to create erosion, especially when the country is over-stocked. Evaporation is very great owing to the high temperatures which prevail almost throughout the entire year. The plane of nutrition is

therefore very unequal, as the animals may be wading through a luscious growth of native grasses at one season and existing on fragmentary dried remains of them for weeks or even months before the wet season comes round again. It is a land of huge properties often measured in thousands of square miles rather than in acres, and consequently the cattle have to travel long distances for food and water, especially in the dry season. Transport is one of the major difficulties, and animals which are in excellent condition when they leave the station have deteriorated greatly after they have been driven 200 miles or so to the nearest railhead or meat-works. The water supply is often a serious problem, although artesian or sub-artesian water is frequently available. With a carrying capacity of only a few beasts to the square mile, it is usually uneconomic to erect fences which would enable sufficient paddocks to be made available for ideal management. It is the real land of wide open spaces, where skilled horsemanship is essential for mustering, drafting, branding and other necessary operations. Fortunately it provides a type of work which appeals to the aborigines, as the general climatic conditions are trying for white people during the summer months.

The whole tropical region is free from rabbits, but kangaroos often eat the young grasses and dig out the roots, while dingoes frequently play havoc with the young calves. Termites or white ants are a continual menace to buildings, fencing posts and yards. Pleuropneumonia lingers in certain localities and it is only quite recently that advancing science has been able to transfer inoculating material in good condition to remote stations. The cattle-tick and the buffalo-fly plague the cattle all too frequently.

It takes a large amount of capital and a great deal of courage to engage in an industry with so many drawbacks and the development has been largely the work of large companies and enterprising citizens like the late Sir Sidney Kidman.

In the tropical regions of Western Australia the cattle country can be divided into two sections—the West Kimberley and the East Kimberley districts. The live cattle from the former are usually exported from Derby and slaughtered in Fremantle. The Western Australian government in 1919 erected large meat-works at Wyndham to serve the pastoralists in East Kimberley, and here a great many of the cattle from the north-western section of the Northern Territory are treated after a long trek through difficult country. The meat-works are thoroughly up-to-date and have facilities for the production of all kinds of

by-products—hides, horns, tallow, ox-tail hair, fertilizer, etc. The capital cost to the State government has been about £750,000 and they have been a financial failure, although without them the cattle industry could not possibly carry on.

There are 43 beef-cattle stations in East Kimberley, mostly on long pastoral leases, some of them extending to a million acres. The cattle are chiefly Shorthorns, with an increasing number of Herefords, but the quality is not high. The lack of proper fencing makes it difficult to control the breeding programme, and many scrub bulls escape attention at castration time, and heifers frequently produce calves at too early an age. The variable nature of the seasons results in long periods of under-nutrition, and five-year-old bullocks seldom dress more than 500 or 600 lb. As already indicated, the bullocks on the station weigh considerably more, but they lose a lot of weight on the long trek to the meat-works and many of the carcasses are rejected for export. The proposed development of an irrigation scheme on the Ord River would enable large numbers of better quality animals to be slaughtered at three years and this would alter the economics of the situation enormously. The recent experiment in slaughtering the animals on the stations and transporting the carcasses by air would also seem to offer possibilities for the improvement of the industry.

The general conditions in the Northern Territory somewhat resemble those in the Kimberleys. There are three main sections of this huge region where the beef-cattle industry is practised—the north-west, Barkly Tableland and the southern section. In between them are interspersed areas of semi-desert country not considered worth developing at present. The north-west immediately adjoins East Kimberley and the majority of the cattle when ready for market are overlanded to the meat-works at Wyndham. Many of the properties are even larger, including the famous Victoria Downs station as well as Wave Hill, Waterloo and others of note. Although some of these are older and better developed, they are subject to the same disabilities, and have to encounter the same problems as those in the East Kimberley region. Vestey's built huge meat-works at Darwin partly to serve this area, but the long distance without railways from the source of supply and insurmountable labour difficulties caused them to be abandoned.

Barkly Tableland in the south-east has not such a good total rainfall as the north-west, but it is a little more reliable and the holdings are rather smaller and more intensively used.

A notable example is Brunette Downs, a property of 10,000 square miles, where herd improvement of the Shorthorns has been possible by greater subdivision of paddocks and the frequent introduction of bulls from prominent breeders in the south. At Anthony's Lagoon some Aberdeen Angus bulls have been introduced to cross with the Shorthorn, and the result of this experiment is awaited with considerable interest. The great drawback here, too, is lack of proper communication. An extension of the Queensland railway system into the Northern Territory would shorten the trek of the cattle to the railheads and cheapen the inward movement of household supplies and materials for the carrying out of improvements.

The southern part of the Northern Territory contains a fair proportion of good pastoral country. Although the rainfall is even lighter than on Barkly Tableland it seems to be still more reliable and this district has better access to markets through the railway from Alice Springs to Adelaide.

The part of tropical and sub-tropical Queensland west of the Great Dividing Range has similar conditions and similar problems to those encountered in the Northern Territory, although a considerable proportion of it is better serviced with artesian water and railway communication. In the south-west corner near the South Australian border, too, there is a remarkable area known as the Channel country which receives periodical natural irrigation from the overflow of the Georgina, Diamantina and other rivers. This is capable of fattening a large number of cattle in certain seasons, but unfortunately at present is farther removed from railways than any other part.

Railway communication with the better rainfall areas east of the Great Dividing Range makes possible the breeding of cattle in the drier parts and fattening them at an earlier age in the more favoured areas near the coast. This scheme is already in operation and could be greatly extended as irrigated pastures are gradually developed along the rivers in central coastal and adjacent regions. Indeed, the central and north coast and hinterland areas of Queensland, with an area of 150,000 square miles, appear capable of much greater development than at present, especially if supplemented by irrigation wherever it can be economically carried out. A research station has been started near Ayr as a joint venture by the Queensland government and C.S.I.R.O. to determine the best grasses and other pasture plants to grow with the aid of irrigation water, and the results will be followed with much interest.

The breeds of cattle used for the production of beef in Australia have undergone considerable modification since the beginning of the century. The Shorthorn and the Hereford are still the most popular, but each of these has improved greatly in appearance and performance. The typical Shorthorn at the beginning of the century was a hardy but rather leggy slow-maturing breed, and many of this type are still to be found on outback stations, but in all the better country there has been almost a revolution in favour of the shorter legged more nuggety and compact early maturing type. The same kind of change had been taking place in the United Kingdom where the Scotch type described above has rapidly gained in popularity with breeders, butchers and consumers. The main credit for the introduction of the improved strain must be given to Anthony Hordern of Milton Park, Bowral, who imported a number of bulls, cows and heifers at great expense, including the outstanding sire, Masterkey. Most of the present-day prize-winning studs have been built up on the progeny of his importations. As Masterkey was calved in 1916 there has been plenty of time for the influence of the Milton Park Shorthorns to be exerted on a large number of herds. The success of the new strain has encouraged other breeders to make further importations, and the breed as a whole has thus been improved as producers of palatable tender early-maturing beef. Even the stations in the less favoured country are beginning to feel the influence, for example, Brunette Downs in the Northern Territory.

The Hereford, too, has greatly improved in the same direction, especially since the Australian Hereford Society was founded in 1917 and a regular herd book for the recording of pedigrees established. Compared with typical animals at the beginning of the century, the modern Hereford is more compact and shapely, earlier in maturing and better fleshed all over. It still retains its hardiness and will thrive under a great variety of conditions. It would be invidious to mention the names of some successful breeders of all classes of livestock without naming others of almost equal merit, but in the case of the Herefords it is difficult to omit the part played by the Reynolds family of Tocal, Duninald and Hobartville in the sustained improvement of the breed.

The possession of horns may add to the appearance of a breed like the Hereford, but it has other quite obvious disadvantages, especially when animals are herded together in yards and railway trucks. The chemical treatment of the sprouting

horns of a calf prevents their development, but it is not always convenient, especially on large stations, to adopt this practice. Sawing off the horns of the more mature animal is not a pleasant job for either the operator or the cattle, and the latter are temporarily prevented from thriving after the operation. From nearly every point of view it would be better if cattle did not produce horns at all. This fact has given rise to the evolution of hornless variants of both the Shorthorn and the Hereford, namely the poll Shorthorn and the poll Hereford, which have both acquired the status of distinct breeds. In all other respects except the possession of horns, they have exactly the same qualities as the horned breed, and both have become increasingly popular in Australia of recent years. The poll Shorthorn is reputed to have been evolved in the United States by breeding from a few animals which happened to be born without horns. They were supposed to be sports, but may possibly have resulted from an accidental cross with another breed like the red poll. D. S. McLarty, of Lone Pine, Riverina, claimed to have been breeding polled or hornless Shorthorns since 1874. The breed has made great headway in the United States and many high-priced poll Shorthorn males and females have been imported from there with a record of polledness on both sides for several generations. The breed in Australia is now in the hands of capable breeders, and if they can maintain a standard even approximately as high as that of the horned breed they may gradually replace them.

The poll Hereford was evolved in the United States in much the same way and has become even more popular there than the poll Shorthorn. It, too, possesses all the qualities of the horned breed and there is a great demand for it in Australia wherever the Hereford thrives, and that, as previously indicated, represents a very wide range of conditions. There seems to be some doubt as to who introduced it to Australia, but it came to notice first in Queensland where A. H. Stirrat, of Euro Stud, Mount Larcombe, and James Sparkes, M.L.A., of Lyndley Stud, Dalby, were amongst the first importers and successful exhibitors. Brisbane's was the first royal show to provide separate classes for them, and they are still more popular in Queensland than elsewhere. They seem to have been first used in New South Wales by the Dearden family of Tenterfield, but the most valuable importations were made by J. H. Doyle of Merewah and Anthony Hordern of Milton Park. These resulted in a quick raising of the standard, which is now particularly high. In Victoria

L. F. Leake of Cudgewa has been the pioneer breeder and exhibitor. The poll Hereford is now increasing in popularity in every State of the Commonwealth, and the general standard of the herds is advancing rapidly.

The North Devon breed, one of the first to be introduced, has still many keen adherents and just about holds its own in comparison with the other breeds. It, too, has improved in the same direction as the Shorthorn and the Hereford in the hands of a few notable breeders like the late Hunter White of Havilah, Mudgee.

The beef-cattle breed which has gained most in favour in the United Kingdom of recent years on account of its early maturity, the quality of the beef and the high percentage of useful parts, is the Aberdeen Angus or poll Angus. It has also had a greater influence than any other in creating the high reputation of Argentine chilled beef on the British market. Very little was heard about the breed in Australia till near the end of last century. The Dennistoun Pastoral Company of Tasmania evidently imported four bulls as early as 1858, but there is no evidence that they developed a herd of pure-breds. In 1885 W. C. Grubb of Tolarno, Tasmania, established an Aberdeen Angus stud which was not dispersed till 1919. Before that, Messrs Kayne and Butchard, stock and station agents, imported from Scotland two Aberdeen Angus bulls and six cows and heifers which ultimately became the property of Mr Pretty of Maribyrnong, near Melbourne. David Syme, the proprietor of the *Age*, imported several representatives of the breed from Scotland and New Zealand and established a stud at Lilydale in 1885. He was a successful exhibitor at Melbourne royal shows and several other Victorians followed his example. George Loder of Abbey Green, Singleton, is credited with the introduction of the breed into New South Wales from purchases he made mainly in Victoria. He was followed by J. R. Smith of Tucka Tucka, Yetman, who founded a noted herd as the result of direct importation from famous breeders in Scotland. The station as well as the cattle were later purchased by the White brothers of Edenglassie, who were amongst the most famous of all cattle breeders in New South Wales. The introduction of the Aberdeen Angus into Queensland was the work of William Hogarth of Balgownie, on the Darling Downs. For a long time the breed was confined almost entirely to a comparatively few isolated studs, owing partly to a curious prejudice against their black colour, and partly to the notion that they lacked the hardiness of the Shorthorn and the

Hereford. In 1927 the Aberdeen Angus Society of Scotland sent out a representative consignment which found plenty of eager buyers, and this gave a great stimulus to the breed. A little later the New South Wales department of agriculture established a stud at Trangie mainly from Canadian importations. Success in that location—the hot dry western part of New South Wales—and in the coldest parts of New England by other breeders dispelled to some extent doubts as to their hardiness, and perhaps no other breed has made such relative progress in recent years. This is a fortunate circumstance, as the many good qualities of the breed can hardly fail to have a beneficial influence on the beef-cattle industry, especially in the more favoured districts.

It is hardly to be expected that breeds of cattle evolved in Great Britain would be ideal for the conditions encountered in the tropical parts of Australia. Under similar climatic conditions various countries in North and South America round the Gulf of Mexico have met with considerable success by crossing British breeds with zebu cattle, which are natives of India. Now the zebu has a conformation which does not appeal in the slightest to those accustomed to British breeds, with a large hump on the shoulder, an abundance of loose skin on the neck and brisket and drooping quarters. They are, however, much better adapted to heat and drought as well as being resistant to ticks and buffalo-flies. The progeny of a cross with a Shorthorn or Hereford still possesses these virtues and the abnormalities are greatly reduced. If these cross-breds are mated with a British breed again, the resultant second cross conforms still more closely to our accustomed idea of what a beef beast should look like and the quality of the beef is practically equal to that of the pure British breeds. Owing to their capacity to tolerate high temperatures, repel ticks and hold their condition in dry seasons, the first and second crosses frequently produce a marketable carcass a year earlier than the pure Shorthorn or Hereford.

In 1933 the C.S.I.R.O., in co-operation with a few prominent pastoralists in north Queensland, imported a number of pure-bred zebus and some crosses from America and they have been mated with Shorthorns and Herefords on a number of stations. Their progeny now runs into several thousands and good reports have been received concerning them. The chief objection seems to be that they are rather wild, fleet of foot and difficult to muster,

but these are difficulties which may be overcome by more careful handling in their early years. In any case, every possible avenue should be explored for the advancement of the beef-cattle industry, as it is becoming more and more difficult for the world's supply of beef to keep pace with the demands of an ever-increasing population anxious to improve their standard of living.

CHAPTER XXIV

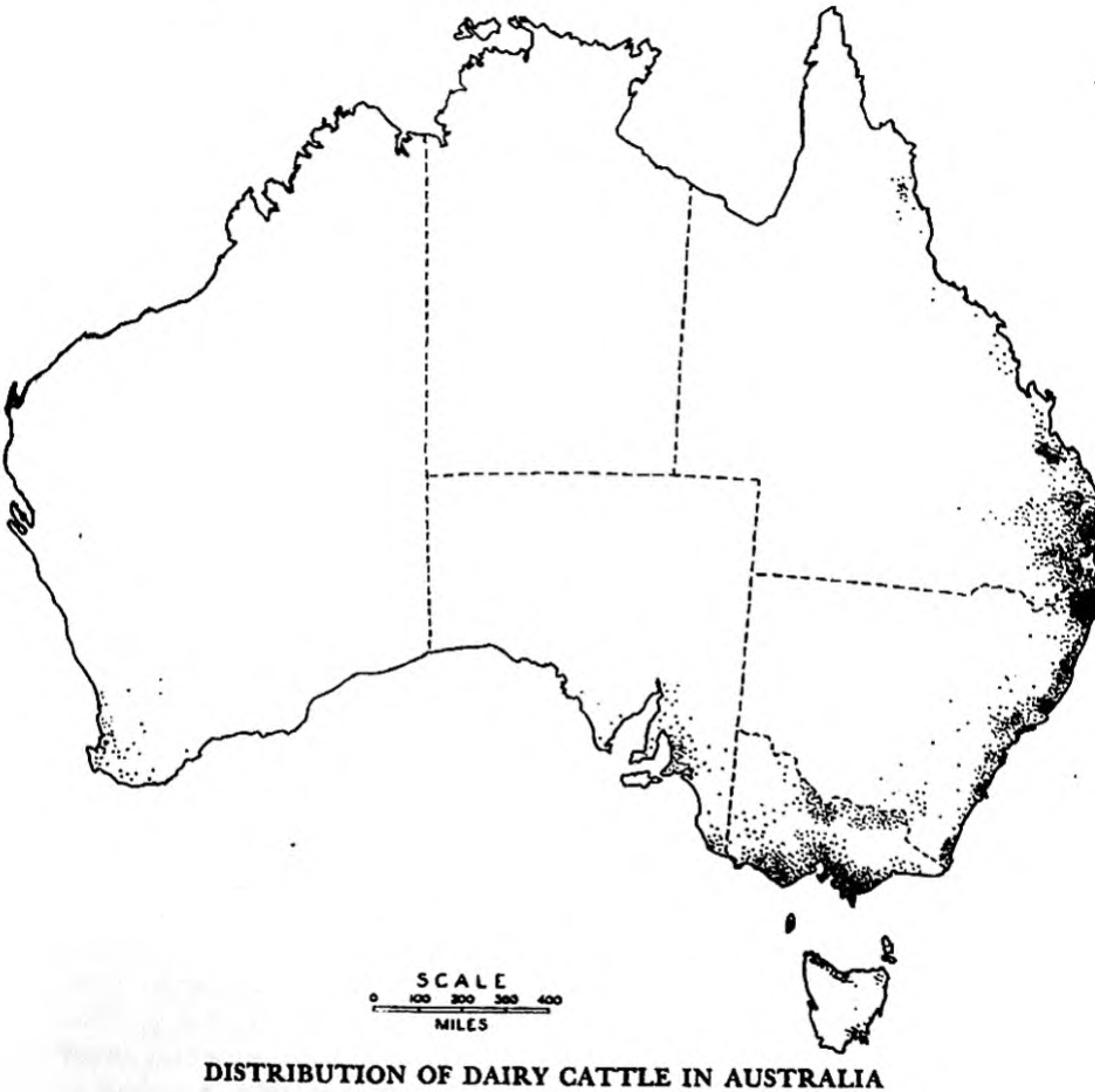
Advances in Dairying

PROGRESS made by the dairying industry since the beginning of the century has been much more rapid than that made by the beef-cattle industry. All of the factors which gave it a fillip in the eighties of last century continued to operate, and there has been a constantly increasing demand for its products. The more than doubling of Australia's population during the period, has meant a corresponding increase in the local demand for milk, butter and cheese, whilst the United Kingdom and other countries have been able to absorb the surplus production of the industry. Practically new products and by-products, like condensed and concentrated milk, milk powders, infant foods, ice-cream and casein have also created fresh outlets.

Neglecting variations due to seasonal differences, the progress was rapid and continuous right up to the beginning of the second world war, since when there has been a slight regression for a variety of reasons. This is illustrated by the following approximate figures:

	1900-1	*1938-9*	*1950-1*
Number of dairy cows	1,188,000	3,200,000	3,000,000
Production of butter (lb.)	101,671,000	446,000,000	367,000,000
Production of cheese (lb.)	11,575,000	65,500,000	100,000,000
Production of condensed milk, etc. (lb.)	2,800,000	72,000,000	225,000,000

It will be noted that the number of dairy cows from the time of federation up to the beginning of the second world war nearly trebled, whilst the production of butter was more than four times as much. During the greater part of the period the chief use of milk not required for human consumption was in the production of butter, and for many years Australia has been one of the three leading countries of the world in the export of that commodity. Although Australia had a small export trade in cheese, condensed and concentrated milk and milk powders



DISTRIBUTION OF DAIRY CATTLE IN AUSTRALIA
Each dot represents 2000 head.

before the end of this period, she actually imported considerable quantities of them in the early years of the century. When war broke out the British government asked Australia to send to her more of them, and that accounts for the increase in their production at the expense of butter during the war period and for some time thereafter. It was not easy to make this sudden change, but the proportion of Australia's total milk production devoted to butter-making declined from 78 per cent in 1938-9 to 63 per cent in 1946-7. The proportion used for cheese-making increased from a very small amount to 8.4 per cent and for condensed milk and milk powders from practically nil to 6.5 per cent, leaving about 22 per cent for all other purposes, including consumption as liquid milk, fresh cream and ice-cream. For the greater part of the war period the butter supply for local consumption was rationed so that the maximum amount of dairy products could be available for the services or for export to Great Britain.

Australia's exports of butter increased gradually from 33 million lb. at the beginning of the century to about 230 million lb. in 1938-9. Since then, unfortunately, the quantity decreased to 120 million lb. in 1950-1. Over the latter period, however, there has been an increase in the export of cheese from 36 million lb. to 45 million lb. and in the export of condensed milk and milk powders from 19 million lb. to 101 million lb.

More creditable than the increase in the volume of production and exports has been the striking improvement in the quality of dairy products, especially butter. This has come about mainly through the application of knowledge acquired by research workers in dairy bacteriology in this and other countries. There has been a definite improvement in the standard of hygienic methods on the farm, resulting in less contamination of the milk and cream in bails and dairies. The milk is usually separated immediately after milking, the separated milk being retained on the farm for the feeding of calves and pigs. The cream is cooled and delivered to the butter factories every day or every second day whenever possible, so that it arrives at the factory in better condition than in the early days, especially in the warm summer months. The first factories, built mainly by co-operative companies, were not planned on the most modern labour-saving and hygienic lines, and many of them had degenerated somewhat in the earlier decades of the century. It is impossible to manufacture a first-grade food product like butter unless facilities exist for scrupulous cleanliness and freedom from

bacterial contamination. In 1916 a stringent Act was passed in New South Wales which compelled all butter factories to come up to this standard. A great many of the old factories were condemned outright and had to be rebuilt, whilst others had to be remodelled to comply with the regulations. There was considerable outcry about the additional expense involved, but the co-operative and privately owned factories had to comply, and there were no complaints a few years later when the greatly improved quality became evident. Up to 1916 slightly more than fifty per cent of the butter made in New South Wales was second-grade—a standard we now regard as only fit for use in the making of cakes and pastry. By 1920 an almost incredible improvement had taken place, as the grading in that year was

Choisest	88.3 per cent (a new grade)
First grade	7.8 per cent
Second grade	3.9 per cent

and the standard has continued to improve slowly to the present day, some individual factories having a record of over 99 per cent choicest butter for a whole year.

Improvement in hygienic conditions on farms and in factories has not been the only factor in this transformation. Others have been the better education of the factory managers and their assistants, improvements in the design of churns and butter-working appliances, the neutralizing of the acidity of the cream when the souring process has gone too far by the time it arrives at the factory, the removal of objectionable odours caused by certain weeds, the control of temperature throughout the whole process of butter-making, and especially the pasteurization and subsequent cooling of the cream before it goes into the churn. Some of the best-equipped factories are now as large, modern and efficient as any in the world. All the other States have followed the example of New South Wales, although none of them has yet reached such a high percentage of choicest butter.

As in the case of butter, the bulk of the cheese in Australia is now made in factories usually run on co-operative lines. Until recently the only cheese manufactured has been of the cheddar type and the general standard of the product is not nearly as high as in the case of butter. This is partly due to technical efficiency not being so high but partly to the fact that different people have such various opinions of what constitutes a good cheese that it is impossible to cater for all tastes. Partly owing

to the influx of so many Europeans who have been accustomed to varieties of cheese other than cheddar, the demand has increased for some of the continental types, and a few progressive factories are endeavouring to cope with this demand, with a reasonable degree of success.

The conventional methods used in other countries for the production of the two main types of condensed milk have been adopted in Australia with quite good results, whilst the standard for dried milk or milk powders is as high as in any country.

The more favoured parts of the Australian continent are as well suited to the dairying industry as any part of the world. One great advantage they have over the leading dairying countries of Europe and North America is that the winters are so mild that the cows do not require to be housed and hand fed for six months or seven months of the year, as is the case there. Shelter belts of trees to protect them from cold winds and rugging of the cattle in the cooler districts and seasons are all that is required to keep them in reasonable comfort and health. Another benefit of the mild winter is that some growth of grass, herbage and forage crops goes on throughout the year, provided that the moisture supply is satisfactory.

With regard to the location of the industry, there has been considerable expansion in those districts of Victoria and New South Wales which were established at the end of last century. The most notable additions to the area have been in south-eastern Queensland and in districts at intervals at or near the coast extending as far north as the Atherton Tableland. There has been quite marked expansion in the south-east of South Australia and the south-west corner of Western Australia, where the cattle thrive on improved pastures, of which subterranean clover is usually the important constituent. The industry has also found a suitable habitat on irrigated pastures, especially in Victoria. When the price of wheat was very low in the early thirties it also extended into the more favoured portions of the wheat belt, where it still persists, especially where a river frontage makes a luxuriant growth of lucerne possible.

Dairy-farming, of course, is a very exacting means of earning a livelihood, since, whatever happens, the cows have to be milked twice a day for the 365 days of the year. Legislation which provides for short hours with extra pay on Saturdays and Sundays, chiefly for the benefit of the city worker, makes the employment of hired labour difficult. The industry consequently is largely dependent on family labour, which is often poorly re-

munerated. The introduction of the milking machine has removed part of the drudgery, but has not relieved the necessity for constant attention to the needs of the milch cows and their youthful offspring. A high standard of efficiency is maintained on a few large estates subdivided into individual farms of reasonable size under skilled management and on others where the owner-occupier takes interest and pride in the improvement of his herd and of his pastures and makes adequate provision for those dry spells which are apt to come along at irregular intervals. Where the dairy farmer has only a short lease or is working on the shares he is, however, too inclined to depend on what fickle nature provides in the way of grazing and to neglect such important matters as fodder conservation, pasture improvement and the maintenance of soil fertility. Besides, he has no real incentive to pursue a progressive policy of herd improvement. The consequence is that the production per cow, although improving, is nothing like so high as it might be. This is particularly true of New South Wales and Queensland, where the seasons are more variable than in the southern States. Thus, for instance, the production of butter in New South Wales in two consecutive years was 90,715,000 lb. in 1924 and 137,125,000 lb. in 1925—a difference of fifty per cent. Now these yields were produced by approximately the same number of cows and substantially the same cows, so that the only possible explanation is that the animals were better fed in 1925 (a good year) than in 1924 (a poor year in most dairying districts). It is obvious that the difference in butter production would have been nothing like as great if systematic fodder conservation had been adopted by the majority of dairy farmers. The yields of milk and butter fat per cow are much lower in Queensland and New South Wales than in countries like Denmark and New Zealand, which are Australia's main rivals in the butter markets of the world. South Australia and Victoria have more creditable records in this respect, and whereas the yield per cow has been almost stationary in Queensland and New South Wales, there has been a gradual improvement since about 1925 in the two southern States. The net result is that the general average for the whole of Australia has increased from about 300 gallons to 350 gallons in the last 25 years. Even 350 gallons per annum is low by world standards, and there is no escape from the conclusion that the yield could be further increased by a general raising of the standard of efficiency on the part of the producers.

With special attention to breeding, feeding and general

management, individual cows in Australia have shown remarkably good records. The number of those producing the equivalent of 1000 lb. of butter in a single lactation period increases year by year. A milking Shorthorn, Melba XV of Darbalara, the property of the Scottish Australian Investment Company managed by the late J. T. Cole, held the world record for combined milk and butter-fat production for many years. Indeed, although the record was made in 1921, it is only fairly recently that it has been exceeded. At the time when she made her accredited record of 3170 gallons of milk, equivalent to 1614 lb. of butter in a year, the average cow in New South Wales was producing only 280 gallons of milk and the equivalent of 120 lb. of butter. Melba XV was, therefore, giving eleven times as much milk capable of producing thirteen times as much butter as the average cow. Wagga Gladys of Hawkesbury Agricultural College herd also held for a time the world record for the production of butter by any cow of the Jersey breed.

There has been little change in the relative importance of the various breeds of dairy cattle since the beginning of the century except that the Australian Illawarra Shorthorn has improved in uniformity and productive capacity and has become more numerous and popular over a wider area.

Australian dairy herds are very healthy on the whole, but three diseases—in addition to tick fever in parts of Queensland—have caused a good deal of trouble. Since Australian cattle live an outdoor life, one would have thought that tuberculosis would not be a serious menace, but it has been fairly common in some districts. The tuberculin test has enabled the disease to be identified at an early stage and it has now been completely eliminated from an increasing number of herds, particular attention being paid to those which supply milk for human consumption. It would appear as if it would be only a matter of time before this malady completely disappears.

Until recently, the two diseases which caused the greatest economic losses to the dairying industry were contagious abortion (brucellosis) and contagious mammitis (mastitis). A vaccine evolved in the United States has worked wonders with the former, the incidence in heifers in New South Wales having been reduced in the last decade from 23 per cent to three per cent. Experiments carried out in Australia have resulted in the elimination of at least one form of mastitis by injecting the udder with penicillin. The affected cows show a rapid response to the treatment and soon return to normal production.

Some alarm has recently been expressed at the decline in the dairying industry and especially in the production of butter for local consumption and export. The reasons for the slight regression have been partly economic, partly political and partly climatic. If the price of milk and its products could be maintained at a satisfactory level in comparison with other commodities, the decline in production should be only temporary. There is still a good deal of land in nearly every State which could be put to more productive use under dairying than under any other form of rural occupation, and still more land where dairying could be an important item in a mixed farming system. With our great prospective increase in irrigated land, dairying should be able to share with other rural industries in the benefits conferred by the equivalent of an assured rainfall all the year round. Even without irrigation, if the methods adopted by our most efficient dairy farmers were pursued by the majority of the others, the yield of milk and dairy products could be increased by at least fifty per cent within a few years without using an extra acre of land. These improved methods might be summed up under two headings—better breeding and better feeding. The progressive adoption of a system of herd testing and retaining only the progeny of the highest producing cows for the future herds would in itself bring about a marked improvement. A still more rapid advance could be achieved if in addition the male parents of our future milking cows could always be derived from a pure-bred high-yielding strain. A well-organized scheme of artificial insemination, distributing the semen from progeny-tested bulls, would greatly accelerate the improvement in yield per cow, as it is doing in Britain and Denmark.

With regard to better feeding, it is too much to expect natural or induced pastures to maintain a sufficiently high level of nutrition for dairy cows all the year round except perhaps where irrigation is practised. Better pasture management, including the introduction of improved species or strains of grasses and clovers, rotational grazing and such things as fertilizing, liming, cultivating and draining where necessary, would greatly improve the carrying capacity on quite a large percentage of dairy farms. In spite of these devices, nearly every year at some time or other it is necessary to provide supplementary feed, and in few parts of the world is it easer than in many of our dairying districts to conserve hay and silage to tide the animals over a period of pasture shortage. The time is ripe for a systematic series of experiments on the economics of obtaining increased yields by adding

concentrates of various kinds to the diet of cows in full milk. In such studies the indirect effect of feeding purchased concentrates on the maintenance of soil fertility should be taken into consideration, especially as this practice is largely responsible for the permanence of the dairying industry in countries like Great Britain, France, Holland and Denmark.

CHAPTER XXV

Other Branches of Animal Husbandry

Horses

FROM the earliest times horses in Australia have played an extremely important part as an item in the means of production of saleable goods, and in the daily life of nearly every rural resident. Until the advent of the mechanical age they were almost his only means of power and transport and one of the main sources of his recreation and amusement. Australians are such lovers of horses and so adept in handling them that there will always be an important place for them in spite of the gradual displacement of horse teams by tractors on farms, and of riding hacks and buggy or sulky horses by cars, trucks, jeeps and even motor bicycles on stations. There are many outback properties, especially in the north, where station hands still spend a large proportion of their time in the saddle, and some farms where the owner still prefers the draught-horse team to the tractor. When considered as a commodity for sale there is a steady demand for race-horses, police horses, trotters, polo ponies and suitable mounts for adults and children, all of which are bred and reared on country properties. The market for heavy draught-horses for city lorry work and for light horses for the Indian export trade has, however, almost completely disappeared.

The main breeds of horses can be divided into two rather distinct classes or types, the heavy draught breeds, and the light driving and saddle breeds, but these two are never separated in statistics collected in Australia, so that their relative importance can only be a matter of conjecture.

Of the draught breeds, the Clydesdale has been found the one best suited for farm work on account of its flinty bones, hard feet, active gait and long swinging stride. A few Shires, the heaviest of all the draught breeds, have been imported in the past for heavy city work and for the breeding of horses for this purpose. They are too slow in their movements and have too great a profusion of hair about their legs to be suitable for

active farm work, especially on wet clay soils. A few have preferred the Suffolk Punch for farm work because of its activity, gameness, docility and the absence of superfluous hair on its fetlocks. Some heavier animals of this breed have been used for lorry work in the cities, too, where they have attracted attention by their uniform chestnut colour. These are all British breeds, and the only draught breed of continental origin that has found any favour in Australia at all is the French Percheron, which attracted the attention of many of our soldiers during the 1914-18 war. They frequently have a beautiful dapple-grey colour, and they make quite good farm-horses for Australian conditions.

The two breeds which have had the greatest influence on the development of the Australian light or saddle horses, have been the Arab and the Thoroughbred. Some of the earliest light horses introduced into Australia came from India and were mainly of Arab blood, and these formed an important part of the foundation stock. Although a few Arab stallions have been imported from time to time, most of the recent arrivals have been thoroughbred mares and stallions primarily for racing purposes, and consequently they have been the predominating influence in later years. Whatever their breeding, Australian saddle-horses have acquired a great reputation for endurance on a moderate diet, and this characteristic made them very popular in the Boer war and the first world war. They have a similar reputation in India, to which country our exports were at one time quite considerable.

By 1860, the first year when reliable statistics became available, the number of horses in Australia had grown to 431,000, and they increased to over one million by 1880. Thereafter their numbers grew slowly till the end of the century, and they were not depleted appreciably by the 1901-2 drought, which took such toll of cattle and sheep. The draught-horses particularly then increased at a very rapid rate during the era of marked agricultural expansion from 1903 to 1915. By 1910 the two million mark was passed, and the maximum of a little over 2½ million was reached in 1918. By this time the internal combustion engine had become a serious competitor, and the numbers have gone down steadily ever since, with the result that the total horse population today is just about a million, or rather fewer than in 1880. In 1910 there was one horse for every two people in Australia, whilst today there is less than one to every eight.

As already indicated, Australia had formerly a considerable

export trade in horses. India was the chief purchaser for army remounts, polo ponies and general saddle-horses. Actually, from the beginning of the century up to 1920 the average number exported per annum was no less than 15,000, exclusive of those used for war purposes. Since about 1920 there has been a gradual decline in the number exported, and it averaged only about 4000 per annum for the five years prior to the second world war, and has almost reached vanishing point today.

Pigs

Pigs have been quite an important factor in the livestock industry of Australia since the earliest days. With some people they are not very popular on account of their lack of intelligence, the odour that is apt to develop if cleanliness of the sties is not observed, and on account of their table manners being of such a low standard. Nevertheless they possess certain distinct advantages over other classes of livestock. They are more prolific, and pig-farming may therefore be started with a small capital, which can be rapidly increased. They show a greater gain in live weight for food consumed than any other, and their carcasses have a larger percentage of saleable parts. They can utilize a greater variety of products and by-products, some of which, like separated milk, might otherwise be wasted. Nevertheless, pig-raising has had a somewhat chequered career in Australia, partly owing to the occurrence from time to time of diseases like swine-fever, and partly owing to the failure, until comparatively recently, to develop any considerable export trade.

Pigs are required for two distinct purposes. The first is the production of pork for the local market, where a compactly formed pig which will mature at an early age is what is required. A short-legged animal, fine in the bone, comparatively short in the body, round in the rib, with well-developed hams, which will furnish a dressed carcass of 60 to 70 lb. at $4\frac{1}{2}$ to 5 months, is, indeed, the aim of those who cater for this market. Australians, however, who are amongst the largest consumers of beef and mutton in the world, only demand about fifteen lb. per head per annum of pork in normal times, as compared with 55 to 60 lb. per head in Canada and the United States. This is partly a matter of climate, as is indicated by the fact that the greatest consumption of pork in Australia is in the cooler months.

The second requirement is for bacon and ham for both local consumption and export. For this class of trade the pig should be long in the back from shoulder to hip, deep in the sides and

thick in the flanks, with long and fairly thick hams. The shoulders and forequarters should be as light as possible consistent with constitution, as the order of value is sides, hindquarters and forequarters. The ideal dressed weight has varied from time to time on both the home and local market with a tendency to increase since the second world war up to 150 lb., which weight might be reached in seven or eight months under good conditions. It should be noted that a great deal of the exports are sent to Britain as frozen pork and manufactured into bacon and ham at the other end, and for this trade it is the second class of carcass that is aimed at. Of recent years the difference between the two types has become less marked, and is now largely a matter of age and size.

For reasons already mentioned, the pig-raising industry has been largely combined with dairy-farming, although when the price of wheat was low, a number of farmers in the wheat belt found it more profitable to market their grain through pigs than by selling it direct. A few have gone in for pig-raising on single-project farms and have made a great success of it. On quite a number of small holdings, mixed farms and even sheep stations, a few pigs have always been kept to help with the home food supply. Then the majority of pigs have a very short life, the numbers slaughtered in any one year exceeding the number recorded for that year. For these reasons it is difficult to get accurate statistics of their numbers. By 1860 the pig population had grown from very small beginnings to 350,000, and they increased to about one million at the end of the nineteenth century. The average number recorded did not vary very greatly from that figure till the outbreak of the second world war, when a special appeal was made for greater production of pork and bacon for the services and for export to Britain. There was a generous response, and the quantity of pig products available for civilian consumption in Australia was rationed for a time. Between 1939 and 1941 the numbers actually increased from 1.1 million to 1.8 million, when the maximum number was attained. Although there was a slight numerical falling off during the remainder of the war period, that was mainly due to a great increase in the number of pigs slaughtered. In spite of the large quantities required to feed the armed forces located in Australia, the exports of bacon, ham and frozen pork in 1944-5 reached the striking total of 51 million lb. in addition to 5½ million lb. of lard. Since peace was declared there has been a

decline in the number of pigs and in the quantity of pig products exported, largely owing to the high price of grain.

Australia as usual had to depend on Great Britain almost entirely for the breeds of pigs with which to carry on the industry. A few, like the Poland China and the Duroc Jersey, were imported from the United States, but they have never become popular. The most widely used breeds have always been the Berkshire of the pork type, and the Tamworth as a bacon pig. Actually the first cross between the two provides the streaky rashers which are so popular on the Australian breakfast table. For pork the Berkshire has recently had a serious rival in the middle white Yorkshire. The Canadian Berkshire, which conforms more to the bacon type, has also gained greatly in popularity in recent years. For the British market the large white Yorkshire and its crosses are most favoured, and there have been many importations of boars and sows of this breed in the last two decades. Formerly the large black or British black was used for crossing with the Berkshire, as the sows usually made excellent mothers, but it has gone quite out of favour. A few other British breeds, like the Wessex saddleback have gained a footing, but the most favoured breeds today are the Berkshire and the middle white Yorkshire of the pork type, and the Tamworth, the large white Yorkshire and the Canadian Berkshire of the bacon type. The first cross between two of these breeds is frequently a more efficient meat producer than the pure-bred, and the practice of cross-breeding is to be commended, provided that it does not lead to keeping sows of the first cross for breeding purposes and thus gradually drifting into indiscriminate crossing and ultimately nondescript progeny.

The two chief maladies which have acted as serious drawbacks to the pig-raising industry have been intestinal worm parasites where large numbers have been bred on small areas, and occasional severe epidemics of swine-fever, which have necessitated the compulsory slaughtering of large numbers of affected swine and of pigs with which they have been in contact.

Poultry

Small numbers of the main classes of poultry were introduced with the first fleet, and, when the young community settled down to the production of a sufficiency of human food, the numbers increased with the growing demand. Throughout the nineteenth century a few fowls, sometimes supplemented by ducks or turkeys or geese, were kept on most rural properties, and made

an important contribtion to the diet of the households of those who owned them. In many cases the surplus poultry products from this source were sent to market. The larger quantities required for cities and towns were mainly obtained from dairy farms, where the keeping of poultry proved a profitable side-line. Since the beginning of the twentieth century a revolutionary change has taken place through the establishment of numerous specialized poultry farms, chiefly in the neighbourhood of the larger centres of population. They are usually well equipped with huge electrically-operated incubators and brooders capable of hatching and rearing thousands of chickens at a time. The result is that poultry farming has developed into a major rural industry, producing large quantities of eggs and frozen poultry for export in addition to supplying the increasing requirements of a much more numerous local population. The gross value of poultry products, indeed, now amounts to something of the order of £33 million annually.

It will be readily understood that the keeping of statistics of the various classes of poultry is even more difficult than in the case of pigs, and the amazing growth of the industry cannot be illustrated by reference to the numbers of fowls, ducks, turkeys, etc. The progress can, however, be gauged fairly accurately by the increase in the number of eggs marketed for local consumption and export. Even these figures take no account of the quite considerable production from unregistered backyard poultry-keepers. The establishment of egg boards or similar marketing organizations in all the States since about 1943 makes the figures for the last eight years fairly reliable, and the numbers are rather impressive. These boards actually received and disposed of 89 million dozen eggs in 1943-4, which increased to 120 million dozen in 1947-8, although there was a decrease to 108 million dozen by 1950-1 owing to the comparative scarcity and high cost of grain and other feeding stuffs.

The Australian poultry farmer has a rather bewildering array of breeds and varieties of fowls from Britain, the continent of Europe, the United States and some Asiatic countries from which to make his choice. As his chief concern has been the obtaining of eggs, the specialized table fowls like the Dorking and the various game breeds have been rather neglected. Of the laying or non-sitting breeds, the most popular has always been the Leghorn, especially the white variety, although the Minorca, the Andalusian and even the Ancona have been used to a limited extent. The dual-purpose breeds are gaining in popularity,

especially the Orpington, the Rhode Island red and the Langshan, whilst the light Sussex, the Wyandotte, and the Plymouth Rock all have their adherents. A few of the latest British breeds evolved at the University of Cambridge with the primary object of easily distinguishing the sexes at a very early age have also found their way to Australia in the last few years. Australia has to her credit the production of a new breed of fowls just as she has in the case of cattle and sheep. This is the Australorp, a development from the black Orpington, rather lighter in weight but a much more prolific egg layer. By many generations of breeding for production and selection to type this is now a very uniform breed, which has attracted attention in several other countries besides its native Australia.

Breeding for high production is an important consideration with all classes of farm livestock, and it is worthy of note that the first egg-laying competitions in any part of the world were carried out at Hawkesbury Agricultural College in 1901. Poultry-farmers take single fowls or pens of fowls to the college at an advertised date. The birds of the various competitors are subjected to identical treatment, and the number of eggs produced in a year counted by a system of trap-nesting. Competitions with a similar technique are now carried out in most progressive countries where egg production is an important industry. The Hawkesbury College competitions are held annually, and some very fine records have been put up by individual hens and groups in pens. In the 49 years of the competitions individual hens have frequently laid more than 300 eggs in a year, the record being 337. For many years the most frequent prize-winners have been Australorps and white Leghorns, although a good laying strain of Langshan or Rhode Island red has sometimes come into the picture. It is rather difficult to say with certainty which is cause and which effect, but the Australorp and the white Leghorn are used more by commercial poultry-farmers than all the other breeds put together. Poultry-breeders with a large-scale plant frequently sell the young chickens in excess of their own requirements to other commercial poultry-farmers and private citizens. This is really a great convenience as it saves all the troubles connected with the use of broody hens, and pure-bred stock of a good strain can usually be ensured. Another interesting new development is the combination of poultry-farming with citrus-growing, with promising results to both industries.

Ducks are nothing like so popular as fowls, as there is not

much demand for their eggs, and they are chiefly reared and fattened commercially for table purposes. There is an objection to them on some farms, as they are apt to render the water in dams unpalatable to horses. The Indian runner and the khaki Campbell are the most popular for laying, and the Aylesbury and the Muscovy duck for table birds. Geese are comparatively rare in Australia, since they are not so popular at Christmas time as in countries where the festive season occurs in the depth of winter.

Turkeys play a comparatively important part in the all-the-year diet of the Australian people. They thrive in a dry and relatively warm climate and escape most of the maladies associated with a cool wet one. The Australian wheat harvest occurs in November and December and, however efficient the harvesting machinery, a good deal of grain is usually spilled on the ground. If the turkeys are allowed to roam over the wheat paddocks, this spilt grain, which would otherwise be wasted, is a timely source of food to fatten them for the local Christmas market. There is undoubtedly a great opportunity for a fairly large-scale turkey industry as a side-line for our wheat-farmers, especially as there is a practically unlimited export market. The availability of day-old turkey chicks from commercial hatcheries renders the starting of the industry on a fairly large scale comparatively easy, and the establishment of killing and dressing stations in country districts has greatly improved the facilities for marketing the birds in good condition. Incidentally, turkeys may help in controlling weeds by eating the seeds of plants like the saffron thistle.

Before the outbreak of the second world war the making of egg powder was practically unknown in Australia, and even the pulping of eggs was comparatively rare. Owing to the saving of shipping space, there was a rapid development of both, and by 1947-8 Australia was exporting no less than 26 million lb. of egg pulp, and 4½ million lb. of egg powder, but these figures had fallen off considerably by 1950-1. Exports of frozen poultry are still of large proportions, being no less than approximately five million fowls, 54,000 ducks and 320,000 turkeys in 1949-50.

Bees

Bee-farming is a fairly common side-line in many parts of Australia and is sometimes practised as a separate industry. The chief drawback to its progress is the great variability in the flow of nectar from the native flora from season to season. Some enterprising bee-keepers have got over this difficulty by carting their

hives about on wagons and camping for a period wherever there are large numbers of eucalypts or other suitable pollen-bearing flora in bloom. The industry as a whole is developing fairly rapidly, and the quantity of honey—31 million lb.—produced in 1946-7 was a record up to that time. Even that figure probably does not include the produce of a great many unregistered bee-keepers who utilize a few hives in order to supply their friends and their own families with honey. In addition to supplying about 5000 tons for local consumption, the exports in that year amounted to 14 million lb., valued at £556,000. There is also a small export trade in bees-wax, although in some years this does not exceed the quantity imported.

CHAPTER XXVI

Pasture Improvement

SINCE the beginning of the present century probably no single factor has contributed so largely to the advancement of the livestock industries as the improvement of pastures, and none offers greater promise for the future. Much has been written about the suitability of the native pastures of Australia for the development of the fine-wool industry. One would naturally expect grasses and other pasture plants which had been evolved in the Australian environment and had become adapted to it to be something approaching the ideal. In the drier and more tropical parts of the continent this is probably approximately true, and it might be difficult to find anything more suitable than the native grasses, saltbushes and other herbage plants for those particular regions. The most productive and nutritious pasture plants, however, never had a chance of reaching the more temperate and better rainfall areas until the arrival of the white man. In quite early days the government botanist, progressive settlers and, later, the agricultural society did introduce some of the most popular English pasture plants like perennial rye grass, Italian rye grass, cocksfoot, meadow fescue and red and white clover. These did, in many instances, excel the native pastures, although they did not always show up as well during drought periods as the native grasses. The fact that no phosphatic fertilizers were then available definitely restricted their utility. Since the application of superphosphate to pastures became a common practice all of these except meadow fescue have become invaluable on the better soils in all the cooler, moister districts of Australia.

In Tasmania and southern Victoria, especially in dairying districts, paddocks are to be found which closely resemble typical British pastures in composition.

Two other useful early introductions were lucerne, which was found to flourish on alluvial soils but was used more for haymaking than for grazing, and prairie grass, which did particu-

larly well in the better rainfall regions near the coast. Few of these pasture plants did very well in the drier inland regions or even in the good rainfall more tropical coastal regions farther north. The clearing of the timber and the much more intensive grazing to which they were subjected altered the whole environmental conditions for the native pastures. There was a marked tendency for sheep and cattle to confine their attention to the finer more palatable grasses with the result that they were eaten out, while the coarser less nutritive ones survived. The removal of timber increased the leaching out of valuable soil constituents and left land vulnerable to water erosion, especially that with a steep slope or where over-stocking was practised. There was also a small annual, but cumulative, loss of soil constituents through the sale of animals, milk and wool from individual properties. As the settlers during the first century or so gave no thought to the replacement of the plant food materials thus removed, there was a definite tendency for pastures to degenerate. The practice of ring-barking increased the carrying capacity temporarily, but rather encouraged the loss of soil fertility.

By the end of the nineteenth century there was a definite need to re-establish the original fertility of the soil and to introduce pasture plants from other countries whose climate was more akin to the drier and warmer parts of Australia than that of the United Kingdom.

In 1881 Baron von Mueller, government botanist in Victoria, obtained from various parts of the world the seed of grasses which he thought might be of value to Australian graziers and dairy-farmers. Amongst others was *Paspalum dilatatum* from South America, which he thought might be useful for sub-tropical dairying districts. It was consequently tried on the north coast of New South Wales, especially on land from which the big scrub had been recently cleared. It attracted the attention of Morton Williams, who did much to popularize it by collecting seed and distributing it amongst his neighbours. By the end of the century it had become the most popular grass in the whole north coast district and it gradually spread south as far as the coastal parts of Victoria and north into southern Queensland. Williams claimed to have carried a cow to the acre all the year round on his own property, and it became almost the mainstay of the dairying industry in New South Wales and part of Queensland. It is a very prolific grower of good nutritious pasture when the rainfall is satisfactory, but it has several weaknesses. It makes very little growth in the cooler months and is apt to form such

a dense mat that it has to be broken up with the plough every few years. It is apt to take complete possession of the land to the exclusion of other useful grasses and clovers. There seems to be no doubt about the fact that many paspalum pastures on the rich volcanic soils of the big scrub country have definitely deteriorated in carrying capacity and yet they do not respond appreciably to conventional fertilizers like superphosphate. There is fairly definite evidence that this, as well as the failure of legumes like white clover to grow well with it, is due to minor element deficiencies and to the absence of the best strains of nodule-forming bacteria. Paspalum of recent years has become subject to a fungous disease of the seed allied to ergot of rye, and altogether it has lost the extreme popularity which followed its early introduction. If it is found that the main trouble is an easily remedied minor element deficiency, it may come into its own again. There is no doubt that it contributed largely to the success of the dairying industry, especially in the north coast district of New South Wales.

Another useful introduction about the turn of the century was the well-known South African grass, Rhodes grass. There appears to be some doubt about who should have the credit for its introduction, but its first enthusiastic advocate was Sylvester Browne, a grazier in the Singleton district of New South Wales. This is rather surprising, as in South Africa it is regarded as a grass for semi-tropical summer rainfall regions. As the result of widespread trials it gradually found its true place in Australia on the richer soils in the sub-coastal districts of Queensland from the Darling Downs to Atherton Tableland. It has many of the same characteristics as paspalum, being equally palatable and nutritious, requiring a rich soil, a sub-tropical climate and a good summer rainfall for its best development, and it has the same tendency to dominate the sward to the exclusion of other grasses and clovers. It has undoubtedly increased the carrying capacity of numerous dairy farms in parts of Queensland, where it generally gives better results than paspalum, especially in districts with less than 40 inches of annual rainfall.

A still more recent introduction suitable to the higher rainfall districts is Kikuyu grass. It was introduced from the Belgian Congo by the late E. Breakwell, when government agrostologist in New South Wales. One peculiarity about it is that it does not normally produce seed and the original supply is stated to have come from a single plant in Sydney Botanic Gardens. It is a

very strong grower and spreads rapidly through the extension of vigorous runners and although only introduced in 1919, it covers a very wide area in eastern New South Wales and Queensland today. It has become a definite rival of paspalum in the north and central coast districts and extends even down the south coast into Victoria. It is more drought-resistant than paspalum and is therefore grown farther inland. It also definitely makes better growth in the cooler weather, but it has not yet been definitely established whether its carrying capacity—a complex of quantity and nutritive value—is quite as good. It covers and takes possession of the ground so rapidly in a suitable environment that it has a special value in checking erosion and in binding the banks of streams and irrigation channels. It has even been successful in choking out such vigorous growing weeds as bracken and blackberry. Altogether it has proved a very valuable introduction.

Another grass of great present and potential value to Australia is *Phalaris tuberosa*, popularly known simply as phalaris or as Toowoomba canary grass. It was originally imported about 1884 with a number of others by Mr Way, curator of Toowoomba Botanic Gardens. His successor in office, R. Harding, noticed how it had spread in the gardens and their surroundings and he was greatly impressed by it. He collected seeds and distributed them to a number of graziers. It grows much better in cooler weather and districts than the three previously mentioned and soon attracted the attention of a number of pastoralists in the New England district of New South Wales, amongst whom the keenest advocate was perhaps Morris Simpson of Stonehenge station near Glen Innes. It has proved invaluable on the northern tableland, as one of the problems in that district of high elevation is to get a grass which will provide a reasonable amount of feed during the winter months. Amongst its merits are drought resistance and the capacity to combine with clovers in a mixed pasture. Its use has since extended to the central and southern tablelands of New South Wales, and its latest use is in combination with subterranean clover in the winter rainfall regions of South Australia and Victoria. There would appear to be no reason why it should not be used as a source of winter pasture in those districts where paspalum supplies the needs of the cattle in the summer months, although there is a danger that it might be crowded out by the paspalum.

None of the English grasses will stand up to the hot dry periods which occur in the wheat belt of the various States. It

would obviously be a great advantage if one could be found to supply feed for sheep in the intervals between cereal crops. H. J. Mullet was the first to record officially the existence of such a grass in the Wimmera district of Victoria in 1919. It obviously belonged to the rye grass family and had evidently been known to the farmers in the district for quite a long time, although no one had taken the trouble to have it identified. As there was for a time some doubt about the exact species, it was simply called Wimmera rye grass and by that name it has been known ever since. It does not require such a fertile soil or so cool and moist a climate as the better-known species of rye grass, and thousands of bushels of the seed are now harvested every year to send to farmers in Victoria and adjacent States. It is easily the most popular and widely distributed grass for temporary pastures in the wheat belt generally.

Green panic and Buffel grass are useful introductions for the drier, and guinea grass and molasses grass for the wetter parts of the tropics and sub-tropics.

These important introductions all belonged to the grass family. A leguminous pasture plant like a clover was needed which would suit the southern winter rainfall parts of Australia, including a large portion of the wheat belt and that for various reasons. Leguminous plants like clovers, trefoils and lucerne are richer in protein than the grasses and therefore more nutritious, especially for animals producing wool, mutton, beef or milk. In some cases they contain too much protein for best results and a mixture of grasses and clovers approaches the ideal diet for most grazing animals. In the northern sections of the wheat belt where there is a considerable amount of summer rainfall lucerne does reasonably well, whilst in others native or introduced clovers and medics help to balance the diet. There is another still more important reason why leguminous plants should be preferred to grasses. Many of our soils are deficient in nitrogen and the amount of this element present in them gets less and less with continuous cropping. Now four-fifths of the atmosphere consists of nitrogen gas, which non-leguminous plants are incapable of absorbing, so that for most plants it is a case of "nitrogen, nitrogen everywhere and not a drop to eat". On the roots of healthy leguminous plants will be found little nodules which are the home of myriads of bacteria which have the power of utilizing the nitrogen of the air in the soil and passing it on in a suitable form to the clover, trefoil, lucerne or other leguminous plant. Instead of depleting the soil of nitrogen, they enrich it in that element

when the nodule-bearing roots decay and other parts of the plant, together with the excreta of the animals consuming it, ultimately become incorporated with the soil. In all progressive agricultural countries, full use is made of legumes in maintaining soil fertility and farmers and graziers always aim at having a fair proportion of clovers in their pastures.

It was quite an epoch-making discovery when a species of clover was found which grew well in the Mediterranean climate of southern Australia. It will be a great day for the Commonwealth if a leguminous pasture plant is found which would perform a similar function in the summer rainfall region.

The introduction and subsequent development of subterranean clover in the southern States reads almost like a romance, and it is doubtful whether any single pasture plant has created such a revolutionary change in the development of any new country. Curiously enough it is not regarded as of any importance in its native habitat round the Mediterranean or in England, where it was probably accidentally introduced. In some places, indeed, it is considered a useless weed. It is an annual but is such a prolific seeder in favourable situations that it behaves like a perennial. It is an exception to the general rule that members of the clover family do not thrive in acid soils. Lime is indeed frequently applied in countries like England, partly with a view to encouraging the growth of clovers and other leguminous plants. That may be one of the reasons for the failure to recognize the value of subterranean clover in Britain and Europe generally. Its introduction into Australia was accidental, and no one at first took much notice of it, partly on account of its poor reputation abroad. Like other members of the clover family, it responds remarkably to phosphatic fertilizers, and when first observed in Australia its growth was not impressive in our phosphate-deficient soils.

It was first definitely recorded in Victoria in 1887, in South Australia in 1889 and in New South Wales in 1896, and before the end of the century it had spread considerably in the two southern States. The man who undoubtedly should get the credit for recognizing its value was A. W. Howard, a farmer in the Mount Barker district of South Australia. He was the first to collect the seed for his own use and to distribute it to his friends and neighbours. He was also the first to apply superphosphate to pastures of which subterranean clover was an important constituent, and he could not fail to observe the quite remarkable improvement in its growth and development through the use

of this fertilizer which had made such a great improvement in the yield of wheat in South Australia at the time. Many farmers in his own State and later in Victoria were induced to follow Howard's example, and thus was initiated the combination of "sub" and "super" which has contributed so phenomenally to the increase in stock-carrying capacity and soil fertility of a vast region of southern Australia. Curiously enough, it was a considerable time before the young departments of agriculture in the various States recognized its value. When they did, the use of the combination spread like wildfire, and it has now become the most important factor in the pastoral and agricultural progress of South Australia, Victoria, Western Australia and a large portion of New South Wales. The stock-carrying capacity has in many cases been trebled or quadrupled and the fertility of huge areas of the poorer soils substantially increased. It actually forms the basis of the dairying and fat-lamb raising industries in many areas formerly considered useless for these purposes. Records show that in 1916-17 only five cwt. of subterranean clover seed were harvested in Australia, which increased to 73 cwt. in 1919-20. By the 1929-30 season more than 250 tons were collected in South Australia alone, and the quantity harvested in all the southern States has gone on increasing ever since. Officers of agricultural departments have done splendid work in isolating early-flowering, mid-season and late-flowering strains of this useful plant and in recommending the best strains for particular districts. This has still further increased its usefulness to the farming community. Another virtue it possesses when it is the dominant constituent of a pasture is that it tends to form a layer of humus-rich material on the surface of the soil, thus making it easier for the rainfall to be absorbed instead of running off the surface and encouraging erosion.

The popularity of subterranean clover largely accounts for the great increase in the area of sown pastures in recent years. The area devoted to them at the beginning of the century is not recorded, but it would be almost entirely confined to dairy farms near the coast from which forest and scrub had been cleared. By 1929-30 the extent of land on which sown pastures were carried had increased to $5\frac{1}{4}$ million acres and it is well over eighteen million acres today, nearly equal to the area under all crops. These figures do not give the complete picture of the land on which pasture improvement has been practised, as they do not include large areas improved by such common practices as drill-

ing or broadcasting subterranean clover and superphosphate across already existing pastures.

Officers of C.S.I.R.O. and of State departments of agriculture are still importing pasture plants from all parts of the world for trial in the hope that some will be found which will be still better than any already here for different soil and climatic regions. Several of these recent introductions already show considerable promise, and there is a great almost untouched field in the selection and dissemination of selected strains of some of our native grasses and other pasture plants.

The introduction of new species of suitable grasses and clovers is not by any means the only factor in pasture improvement. Quite considerable areas of water-logged and swampy land in nearly all the States now carry abundant pastures through the initiation of wholesale drainage schemes. Rotational grazing and the better distribution of the droppings by harrowing and similar devices have increased the productivity of many pastures on dairy-farms. The irrigation of natural and sown pastures has multiplied the production many fold in regions where it can be practised.

The application of lime in various forms has corrected acidity in other cases. By the beginning of the present century the practice of applying superphosphate to wheat was well established, but few seemed to have thought it an economic proposition to apply it or any other fertilizer to pastures. Even before subterranean clover came into the picture, experiments in Victoria and South Australia showed that a profit could be made by applying about two hundredweight per acre to natural or induced pastures. This brought about an improvement in both the quantity and quality of the pastures and in the productive capacity and health of the livestock grazing on the fertilized areas. It actually enriched the soil in two of its most important constituents—phosphates directly and nitrogen indirectly—and thus increased soil fertility instead of depleting it. As the area under subterranean clover grew, the practice became much more universal and in 1949-50 over thirteen million acres of pasture received fertilizer treatment, chiefly with superphosphate. It would be difficult to estimate what this has meant in the production of milk and dairy products, beef, mutton, lamb and even wool. Spectacular results in pasture improvement and in the health of stock have also been achieved in many districts through the correction of deficiencies of minor elements in the soil. Fuller reference will be made to this in a later chapter.

It is probably not too much to say that if known methods of pasture improvement, including the correction of trace element deficiencies, were put into practice to the greatest possible extent, the stock-carrying capacity of the Commonwealth could be doubled and the general fertility of immense areas permanently improved.

CHAPTER XXVII

General Agricultural Progress

THE first 112 years of white settlement in Australia were mainly occupied with the development of the pastoral and, to a lesser extent, the dairying industries. This was natural, since it required comparatively little effort to utilize the natural pastures for the production of such commodities as wool, mutton, beef and butter, for all of which an export market was readily available. The actual area cultivated was comparatively small until the last two decades of the nineteenth century, since farmers aimed simply at the production of the grains, fruits, vegetables, etc. required for local consumption. The fifty years since federation have been noteworthy for the inauguration of a great agricultural era. The progress in the growth of cultivated crops has been much more rapid than in all the other rural industries during this period.

Grain and Forage Crops

The area under all crops in the Commonwealth increased from 8.8 million acres in 1900-1 to 25 million acres in 1930-1, although there has been a considerable decline since then owing to a falling off in the acreage under wheat for grain and hay. This decline in the amount of land devoted to wheat in recent years has been compensated to a great extent by the higher yield of grain per acre and by the increased area under more valuable crops. At the time of federation the export of wheat from Australia had just commenced as a tiny trickle, but it was not very long before the Commonwealth rose to third or fourth position amongst the wheat-exporting countries of the world—a position it has maintained up to the present time.

With an area of about ten million acres wheat for grain is still the most important crop, but it does not occupy the pre-eminent place which is formerly enjoyed. About 4½ million acres, for instance, are now devoted to the growth of hay and forage crops for the feeding of various classes of livestock, and there is

every indication that this will continue to increase. The chief crops grown for hay are oats, wheat and lucerne, although the fodder requirements are frequently supplemented by hay made from the surplus production of natural or improved pastures. For green feed oats are the most generally used, although a great many other crops are now grown for this purpose, including barley, rye, lucerne, maize, sweet sorghum, cow-cane, millets and various annual grasses.

Other Cereals

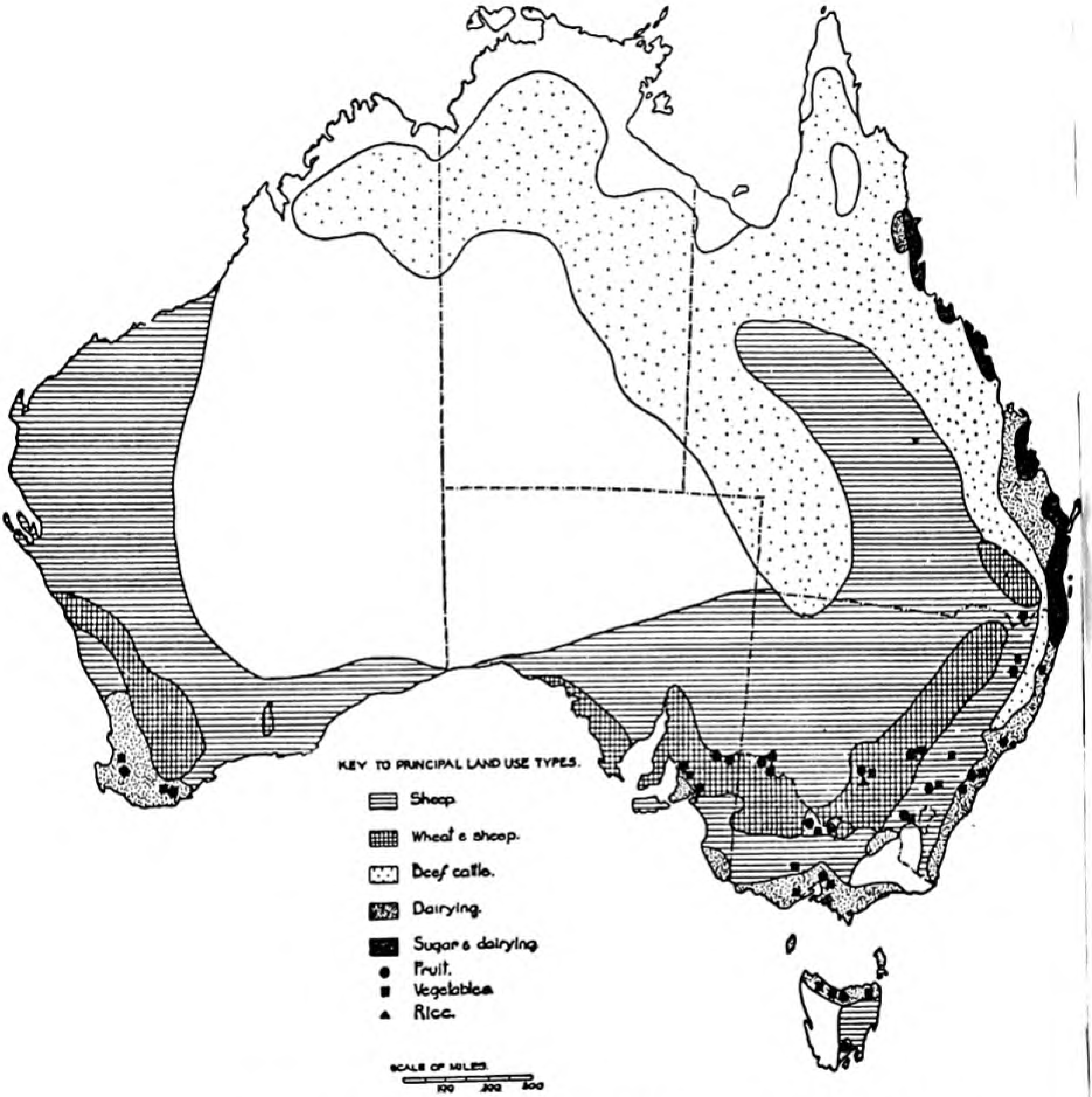
Oats succeed best in a relatively cool and moist climate, and the varieties grown in the United Kingdom fail to do well in most parts of Australia. The Algerian oat (a slightly different species), which was introduced early in Australia's history, suits our conditions much better. The most striking advances in oat cultivation since the beginning of the century have come through the production by Australian plant breeders of a number of new early-maturing drought-resistant varieties which have enabled the successful growth of this crop over a wider area than was formerly thought possible. Besides being the most popular of all crops for hay and grazing, it is second in importance of the cereals grown for grain with an area of about two million acres and is now used in rotation with wheat in all but the driest parts of the wheat belt.

At the beginning of the century Australia was actually importing barley for malting and other purposes, as early experiments with this crop were not successful. Suitable locations were ultimately discovered in South Australia and Victoria for the growth of a good quality of malting barley, and the best varieties for our conditions were ascertained after numerous field trials. Today Australia's requirements for all types of barley are fully met by local production, and a growing export trade in malting barley has been developed.

Maize was a useful early introduction from South Africa and rivalled wheat in importance when the Hawkesbury River flats constituted the main agricultural region. For a long time its growth was confined to the rich river flats in the coastal regions of New South Wales and northern Victoria where some high yields were obtained in good seasons. There it has had to compete with other crops and other methods of utilizing the land, and the area in these favoured regions has actually declined in the last few decades. The introduction of early maturing

varieties enabled the industry to find a footing on the much cheaper land of the northern tablelands and some other inland districts of New South Wales, where the area is gradually increasing. Queensland has a much larger extent of land with suitable soil and climatic conditions for this crop, and it now grows more maize than all the other States put together. The maize-growing industry has received a great fillip in recent years through the production of new hybrids between in-bred varieties, thus increasing the yield per acre by at least 25 per cent. With the increasing demand for drought-feeding and for the pig and poultry industries, as well as for the preparation of breakfast foods, there would appear to be great opportunities for extending its production especially with the present and prospective high prices of all classes of grain.

No one who has seen rice-growing practised in Eastern countries with their small paddy-fields and a tremendous expenditure of human labour would be likely to think that it would be a suitable industry for Australia. A partly mechanized rice-growing technique has, however, been in existence in Italy, California and some of the southern American States for a considerable time. Experiments were therefore carried out on the Murrumbidgee irrigation area which showed great promise. In 1924-5 the first commercial area of 153 acres produced 16,240 bushels, with the rather remarkable yield of 106 bushels per acre. This encouraged a number of settlers to take up the cultivation of the crop, especially on soils too heavy for horticulture, and the area gradually increased to about 24,000 acres prior to the second world war. This was just about enough to supply local requirements, and it was decided to limit the area to about that extent, and to confine the industry to the Murrumbidgee irrigation area. When Japan entered the war in 1941 there was a greatly increased demand for rice for New Guinea and some of our allies, and Australia was asked to increase her acreage, which went up to 34,000 acres in 1942-3. Even that was not sufficient, and rice was practically removed from the diet of Australian civilians and an additional area planted by the New South Wales government on the Wakool irrigation area. This project, though hastily arranged, was well carried out and the area increased to over 49,000 acres in 1943-4. The result was a record crop of about 4 million bushels, with the high average yield of 98 bushels of paddy (unhusked) rice per acre. The average over the whole period since the inception



PRINCIPAL USE OF LAND THROUGHOUT AUSTRALIA

of the industry has been well over ninety bushels to the acre, easily the highest of any country in the world. This fine achievement would not have been possible without the careful selection of varieties and the isolation and use of strains of these varieties best suited to our unusual conditions and the carrying out of trials with various fertilizers and rotations until the very best practices were ascertained. The industry is now more completely mechanized than in any part of the world except perhaps California. With the knowledge and experience thus accumulated, the rice-growing industry could be greatly expanded in the three eastern States, where an abundance of irrigation water is available, if world demand and world prices should justify such an extension. It is also a possible future industry for the Northern Territory, the north of Western Australia and New Guinea.

Sweet sorghum has been grown and utilized by dairy farmers for green feed or silage for a long time. Varieties of grain sorghum, like Kaffir corn, were also introduced from South Africa, but the growing for grain did not become popular till very recent years. Two of the chief reasons were the difficulty in harvesting and the lack of familiarity with the crop and with its potentialities as a feeding stuff. In spite of the adhering husk, its nutritive qualities are not far below those of maize and it has the advantage over maize that it will grow in a drier climate and set seed better in arid hot conditions. Numerous trials showed that it grows quite well and produces good yields in many parts of Queensland and in the north of New South Wales as well as in the irrigation areas farther south. Its recent popularity is due mainly to the introduction of short-stemmed varieties which can be easily and economically harvested by a modification of the ordinary wheat-header. The area recorded in 1939-40 was only 4500 acres but this rapidly increased to 63,000 acres in 1944-5 when $1\frac{1}{4}$ million bushels were harvested. The inauguration of the sorghum-growing scheme of the British government in order that Australia might have a large export of pig products helped to swell these figures. Although the seasonal conditions under which much of the crop is grown are not very reliable, the fact remains that a useful new crop has been added to the list of grains available for the feeding of pigs and poultry, and as a drought supplement for sheep and cattle.

A crop very closely allied botanically to the sorghums—as previously noted—is broom millet. It is a dual-purpose crop, as the panicles are used for the making of brooms while the seeds are useful as stock feed. The technique of growing the crop is

very similar to that used for maize, although great care has to be taken with the harvesting and preparation for market. From time to time there has been a considerable importation of broom millet from California and Italy, but there seems no reason why the present area of about 5000 acres should not be expanded to meet the full requirements of our broom manufacturers.

Some of the true millets, like Japanese and Manchurian millet, are being increasingly used both as a source of fodder and for their tiny grains, for which there is a considerable demand for bird seed. Canary grass is also grown to a small extent for the latter purpose in southern Queensland.

Sudan grass, which is closely related botanically to the sorghums, is proving a very valuable crop for hay and grazing in all districts with a good summer rainfall.

Fibre Crops

Although a small area of flax was grown in the neighbourhood of Parramatta in the early days of the Colony and a little cotton was grown in Queensland when the price rose with the American civil war, the amount of vegetable fibre produced in Australia at the end of last century was negligible. A small flax-growing industry later grew up round a mill established at Drouin in Victoria, and it was encouraged with the aid of a bounty especially during the 1914-18 war. The maximum area achieved, however, was only about 1600 acres in 1919-20. This gradually declined to less than 200 acres in 1928-9, and it looked as if the industry would go out of existence altogether. A renewal of the bounty in 1935 brought about a slight revival to 1358 acres in 1938-9. One harmful effect of the outbreak of the second world war was that a large portion of the supply of flax from Europe to the United Kingdom was cut off and an urgent S.O.S. was sent out to various parts of the empire to increase the area under the crop. Australia was urged to plant up to 50,000 acres as soon as possible, and the requisite amount of seed was sent out.

This was a difficult task for Australia to fulfil, as so little was known about where the crop could be grown successfully and all the rather complicated arrangements had to be made for the retting, scutching and other operations necessary to separate the fibre. Australia rose to the occasion and by 1942-3 had 56,000 acres under crop, which increased to 61,000 acres in 1944-5, and the fibre, though not always of first quality, was of great service

to the allied cause. Financial assistance to the scheme lapsed in October 1946, and since then the area has declined. An attempt is still being made to retain the industry on such a scale as to supply local requirements, for which an area of about 30,000 acres would be necessary.

Cotton-growing has had a chequered career in Australia. There is a large area in Queensland near, though not at, the coast, where the soil and climatic conditions are suitable for the growth of this valuable crop. The technique of growing it presents no great difficulties except those connected with a rather erratic rainfall. Quite a good quality of cotton, corresponding to the best American upland, can be produced, but the cost of harvesting under Australian conditions is higher than in any country in the world and the rise and fall of the acreage has been due largely to economic considerations, especially the average price in world markets. There was a great boom in the industry in Australia after the 1914-18 war, when world prices rose sensationally, mainly due to the spread of the destructive cotton boll weevil in the United States, which is much the most important producer. In 1914-15, for instance, the average price of American upland cotton was 3.6 pence per lb., while in 1919-20 it reached the record figure up to that time of 17.8 pence per lb. It took Australia a few years to recognize the opportunity then offered, but the area under cotton here increased to 50,000 acres in 1924. Then world prices began to fall, and the Queensland acreage correspondingly declined to 15,000 acres in 1927. The Commonwealth government then offered a small bounty, which just about kept the industry going at the 1927 level. The bounty was increased in 1933, and the area under cotton in Queensland went up again to a maximum acreage of 66,000 in 1937. This diminishing bounty expired in 1940, but a new Act extended it in a modified form till the end of 1946, by which time the area had fallen away again to about 8000 acres. The Act was amended again in 1946 so as to offer a guaranteed price of 1s. 3d. per lb. for the next five years, but this has had little effect in increasing the area devoted to this crop. Valuable investigations have been carried out into the best varieties to grow, the correct fertilizers to use, the most suitable rotation of crops and the control of diseases and pests. With the accumulated knowledge acquired on these matters, with the provision of irrigation facilities where required and with the evolution of a really satisfactory cotton-picking machine, there would appear to be great opportunities for future development at least up to supplying the full require-

ments of Australian manufacturers, which would necessitate an area of about 200,000 acres.

Sugar Crops

Small amounts of sugar are derived from the sugar-maple tree and from certain species of palm and sorghum, but the great bulk of the world's supply comes from two plants in approximately equal amounts—sugar-cane and sugar-beet. Considerable areas near the coast of northern New South Wales and especially Queensland fulfil the exacting requirements of the former crop. We have already seen that there was a considerable development of the sugar-cane industry at the end of last century, largely dependent on coloured labour for the outdoor manual operations. When the white Australia policy was brought into force at the time of federation there were many predictions that it would gradually fade away. With the assistance of bounties and fixed prices for local consumption, it has, however, grown into the second most important in money value of all the purely agricultural industries in Australia. It has, moreover, a special value in that it has led to the successful settlement on small individual areas of large numbers of prosperous farmers within the tropics. It is a striking fact that Australia, the only country which grows and harvests cane sugar entirely by white labour, is seventh in importance amongst cane-producing countries with about 350,000 acres under crop and an annual production of about a million tons of refined sugar worth over £25 million. The home consumption price is frequently considerably higher than the export price, and this tends to limit the area, as the average return to the grower gets less and less as the proportion exported increases. In recent years the value of the exports has varied between £1½ million and £4 million and the local retail price of refined sugar has seldom been higher than five pence per lb. Australia's surplus production was of great service to the allies during, and immediately after, the recent war. A fuller account of this interesting industry will be given in a subsequent chapter.

Sugar-beet is a cool-climate crop which could only be a successful enterprise when grown within a limited distance from a sugar factory. Owing to the incidence of the rainfall in southern Australia it has to be irrigated to have any reasonable chance of success. A small beet-growing industry was started early in the century near Maffra in Victoria, where irrigation water was available, and a sugar mill was erected. The greatest area devoted

to the crop was a little over 4000 acres in 1938-9, and it has contracted considerably since then, as it has not been able to produce sugar quite so cheaply as in the case of sugar-cane.

Fruit Culture and Viticulture

Fruit culture, as we have seen, had developed to quite a considerable extent before the federation of the States, but the figures for the area and production were small compared with those of the present day. This is not merely on account of the augmented requirements of a greatly increased population but because Australia has seized the opportunity to export considerable quantities of fresh, canned and dried fruit as well as jams and jellies of various sorts. The extension of irrigation has helped the fruit culture and viticulture industries more than any other. There has also been a greater realization of the possibilities of producing tropical and semi-tropical fruits like bananas, pineapples, papaws and mangoes. The total area devoted to fruit culture is now over 250,000 acres, and as the individual holdings growing fruit are comparatively small, the industry finds employment for quite a large population. Apples are still the most widely grown crop, followed by citrus fruits, bananas, peaches, pears, apricots and plums. The gross value of orchard products in recent years has been approximately £26 million per annum while the value of exports in 1949-50 amounted to £11 million. The latter included about £4 million worth of fresh fruit, chiefly apples, pears and oranges, £660,000 worth of dried fruits, chiefly prunes, £4 million worth of canned fruits, chiefly peaches, apricots, pears and pineapples, and about £2½ million worth of jam and jellies.

Viticulture has made similar progress for similar reasons. The raisin and currant industry is entirely confined to the irrigation areas, which normally experience high temperatures and a low rainfall in the summer and early autumn, which favours the drying process.

An increasing proportion of table grapes and grapes for wine-making is also produced under irrigation. The area under vines has expanded steadily but is rather less than half of that used for fruit growing. It has averaged about 128,000 acres for the last ten seasons, with nearly half the acreage in South Australia, followed by Victoria, New South Wales and Western Australia. Nevertheless the quantity of table grapes, which occupies about seven per cent of the total area under vines, showed an average production of over 15,000 tons for the last ten years. The greatest expansion has been in connection with dried fruits of

the vine, with an average production of 85,000 tons per annum of sultanas, lexias and currants. The production of wine has also expanded rapidly with an output of over 18 million gallons per annum, although in 1945-6 it amounted to nearly 26 million gallons. Table grapes are not exported to any great extent, although considerable quantities are now sent from Western Australia to Ceylon and other countries within reasonable distance by sea. Some varieties, with proper care on the voyage, have been found to arrive in Britain with the bloom still on them and there may therefore be opportunities for expanding this branch of the industry. Raisins and currants to the extent of £2 million to £3 million are annually exported, although up till 1912 Australia produced only enough for her own consumption. Australian wines have been finding great favour abroad and in 1946-7 over £1 million worth were exported chiefly to the United Kingdom but also to Canada, New Zealand and other countries. The export of raisins, currants and wine to Canada is proving useful in connection with the dollar exchange problem.

Vegetable Crops

The chief vegetable crop grown on a field scale in Australia is the potato. As it is unsuitable for export except to New Guinea and the near Pacific islands, growers of this crop simply endeavour to supply the local market. The area has increased with the population, from 70,000 acres in 1901-2 to 150,000 acres today, although the excessive demand during the war period increased it to 242,000 acres in 1944-5.

The potato has rather exacting soil and climatic requirements, which are of most frequent occurrence in Victoria and Tasmania. These usually send considerable quantities to New South Wales and Queensland. The varieties grown in the beginning of the century were chiefly obtained from Great Britain and the United States and the majority of them were not suited to Australian conditions and some were very susceptible to the multiplicity of fungous and virus diseases which affect this crop. A few more recent introductions from America and new varieties produced by plant breeders in Australia have proved higher yielding and more resistant to disease, and these, together with improved cultural methods and a more intelligent use of fertilizers, have increased the average yields.

Other vegetable crops for human consumption grown on a field scale to a lesser extent are turnips, cabbages, cauliflowers, onions and various types of beans and peas. Most of them, together with

all other vegetable crops at the beginning of the century, were mainly grown by Chinese market gardeners in the neighbourhood of the chief centres of population. A great change has come over the industry since then as the Chinese, with their laborious methods of hand cultivation and watering, have been gradually replaced by Australians using horse-drawn implements and even tractors and more up-to-date irrigation methods for large-scale production. A great and sudden improvement in all phases of the industry took place after Japan entered the war at the end of 1941 and the Commonwealth became the base for Australian and allied services in the south-west Pacific area. The very latest implements and labour-saving cultural devices were obtained from America, new methods of dealing with weeds were adopted and the area under vegetables other than those grown on a field scale increased in a very short time from 100,000 acres to double that area. War conditions also gave a great fillip to the preservation of vegetables by dehydration and canning. The former method has declined in importance since peace was declared, but efficient canning factories have been established in many parts of the Commonwealth, producing a great variety of products for home consumption and export.

Another recent development has been the glass-house culture of tomatoes, so that an abundant supply may be available during the cooler months.

Miscellaneous Crops

Tobacco

The tobacco plant, as previously recorded, will grow under a great variety of climatic conditions from Canada and Ireland to Cuba and the Philippines. It grows readily in many parts of Australia, but the product does not always suit the palate of the modern smoker. A special type is necessary for each of the main uses to which it is put—cigar filler, cigar wrapper, cigarettes and light and heavy pipe mixtures.

It is not easy to achieve just the correct colour, texture and burning aroma required for each type, as these seem to depend on a subtle and little understood combination of soil, climate and curing technique. It is important that Australia should produce a larger proportion of her own requirements in order to save the annual drain of about £5 million which goes chiefly to the United States for imported leaf.

In the eighties of last century it looked as if tobacco-growing might develop into an important industry in Australia, as the

area under crop was 6600 acres—just a little less than the average area devoted to it today. That tobacco was grown almost entirely on rich alluvial flats, chiefly in New South Wales, and cured by rather primitive methods. The quality was not the best and mainly consisted of leaf only fitted for dark, heavy pipe mixtures. It was unfortunate that about the turn of the century the demand for this type lessened rapidly and that, apart from the cigar type which we can hardly hope to produce, it has concentrated ever since on the cigarette and light pipe tobaccos. It was gradually realized that to produce the latter types lighter sandier soils must be selected for its cultivation and modern flue-curing methods adopted which give full control of both temperature and humidity during the curing process.

These methods are now in pretty general use and a great deal of investigation has taken place regarding the best locations for the industry and the ideal cultural practices. There has been a considerable improvement in quality resulting from the putting of the findings into practice, and yet few people care to smoke tobacco from leaf wholly produced in Australia. There was a time when our Australian manufacturers were afraid to incorporate more than about five per cent of Australian leaf in their pipe mixtures. They are now, however, using about twenty-five per cent Australian and it is hoped that the quality of the local leaf may improve to such an extent that fifty per cent or more can be used without decreasing the demand. The average area under the crop for the last ten years has been 7800 acres, with a tendency to decrease in spite of a price which is considerably greater than its value in the world's markets. The chief hope for the industry seems to lie in sustained efforts to improve the average quality. A few years ago the whole industry was threatened by a fungous disease, popularly known as blue mould, which decimated a large proportion of the seedlings. A novel method of treatment devised by Dr Angell of the C.S.I.R.O. has proved a complete cure. It is noteworthy as being the first successful attempt to combat a fungous disease by the fumes of a volatile fungicide.

Peanuts

Peanuts or ground-nuts have been grown on a small scale at various places in eastern Australia for many years and sold to confectioners or for direct consumption either raw or roasted. After many trials a suitable location for a concentrated industry was found in the Kingaroy district of Queensland where a mill

costing £50,000 was erected for the extraction of the oil and the manufacture of the residue into a useful concentrate for cattle. The area has gradually increased to 25,000 acres, with an annual production of about 13,000 tons of nuts. Considerable quantities have been imported, chiefly from India, but it looks as if the production in Australia will soon be able to supply all local requirements.

It is interesting to note that, apart from vegetables grown during the recent war, peanut-growing is about the only purely agricultural industry which has been practised in the Northern Territory.

Linseed

Linseed is derived from the same plant as flax. Although a small quantity of seed is obtained as a by-product of the fibre flax industry, the choice of variety, climate and cultural treatment is quite different when linseed is the objective. Varieties have been evolved which give a high yield of seed and would be quite unsuitable for the production of fibre. A warmer drier climate is usually chosen and the seeds are planted farther apart so as to encourage the production of a larger proportion of flowers and therefore of seeds. A suitable habitat for linseed has been found in the Darling Downs of Queensland and the north-western slopes of New South Wales. The establishment of the industry in these two localities is a new development, and the results so far obtained are rather promising. It is hoped that the industry will continue to expand and develop to such an extent that it will relieve Australia of the necessity to import linseed from India and the Argentine for her growing requirements of linseed oil.

Hops

At the beginning of the century fewer than 600 acres of hops, about half of which were in Victoria, were grown in Australia and this was not quite sufficient for local requirements. The picturesque industry is now mainly concentrated on the banks of the Derwent in southern Tasmania. The production varies a little from year to year, but the 1400 acres now devoted to the crop usually just about supply the needs of Australian brewers and the manufacturers of soft drinks. The average annual production is about 1000 tons, valued at approximately £250,000.

CHAPTER XXVIII

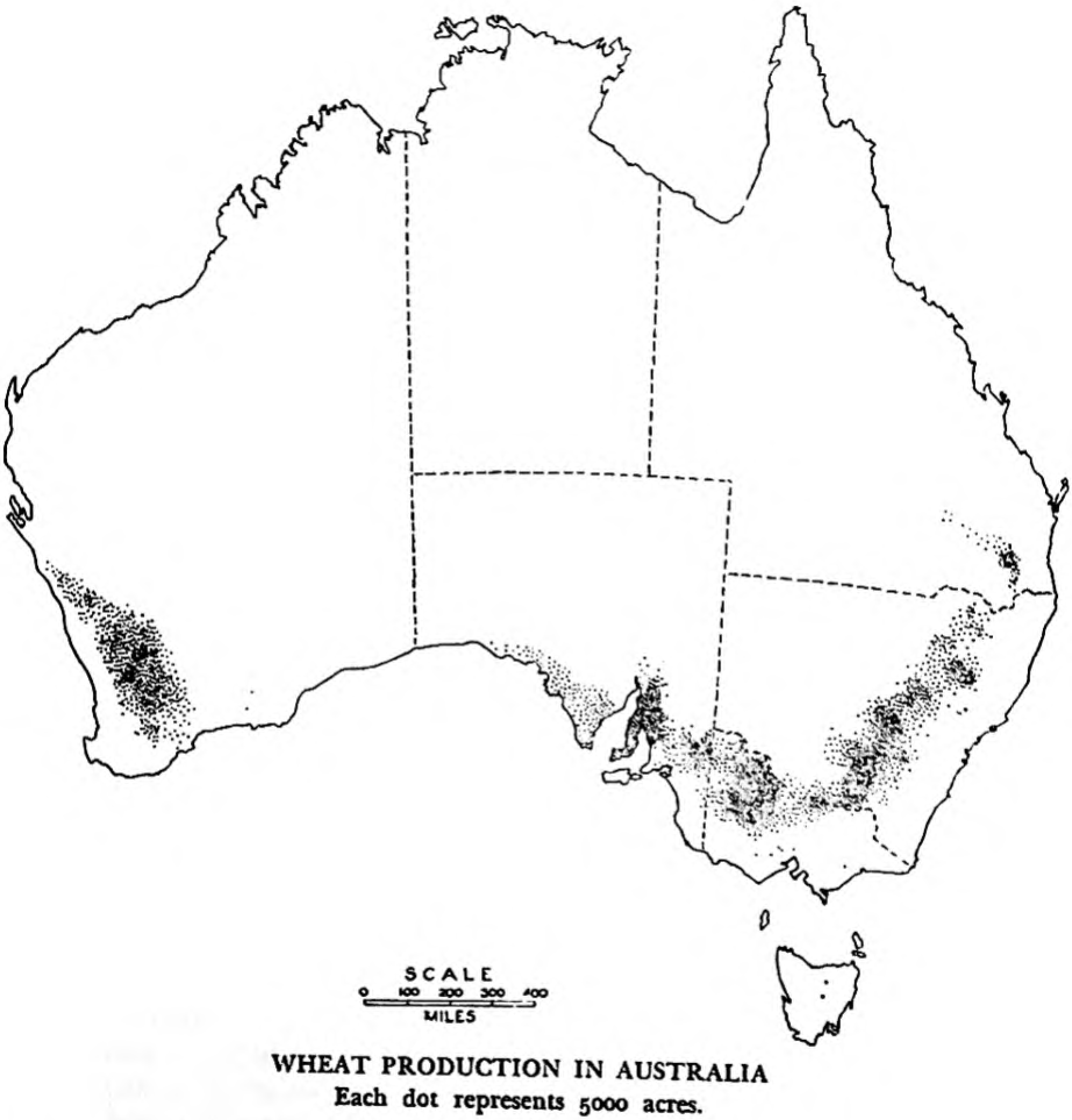
The Romance of Wheat

As bread is the staple food of the white races the growth of wheat and the possible limits to its production have always attracted widespread interest.

In 1898, for instance, Sir William Crookes, the eminent British scientist, rather startled the world by predicting that by the year 1931 it would require all the possible wheat-growing land on the earth to produce sufficient to feed the estimated increase in the population of bread-eaters by that date. He qualified his gloomy prophecy by suggesting that the advancement of science might postpone the evil day for a considerable period. He did not think that Australia would ever have any appreciable quantity of wheat for export. At the time he spoke he had some justification for this opinion, for Australia was having a bad time with droughts in some years and rust epidemics in others and had not up till then exported any appreciable quantity of grain or flour.

After the breaking of the 1902 drought, the Commonwealth experienced a rapid and sensational advance in wheat-growing which was maintained up till 1915. In that year an appeal was made to farmers to make a special effort to increase production, as food was to be regarded as much a munition of war as guns or explosives. The response of the farmers, coupled with a good season, resulted in much the largest harvest up to that time and for many years thereafter.

South Australia and Victoria, the pioneer wheat-growing States, expanded their area during this period, especially in the rather unpromising Mallee districts, where the combination of fallowing and superphosphate gave surprisingly good results. In New South Wales an extensive area of land which has been regarded as suitable only for grazing was properly cleared, ploughed and sown with wheat, giving satisfactory returns in good seasons in spite of the rather primitive methods at first employed. The influx of a large number of farmers from the southern States with their improved technique, together with



WHEAT PRODUCTION IN AUSTRALIA
Each dot represents 5000 acres.

useful extension work done by officers of the department of agriculture, by degrees brought the standard of farming to a satisfactory level, and New South Wales gradually took her place as the leading State in wheat production. Then Western Australia suddenly came into the picture as a wheat-growing State. She gradually realized that much of the land in the twelve-inch to fifteen-inch rainfall belt to the north and east of Perth gave better results from agriculture than from grazing and the expansion of wheat-growing was relatively greater than in any of the other States.

Some of these points are well illustrated by the following statistics.

	Area Under Wheat (*Acres*)		*Yield* (*Bushels*)	
	1900-1	*1915-16*	*1900-1*	*1915-16*
New South Wales	1,530,000	4,186,000	16,173,000	66,700,000
Western Australia	74,000	1,734,000	775,000	18,236,000
Commonwealth	5,666,000	12,484,000	48,343,000	179,000,000

Sir William Crookes's faith in what science might do to postpone the advent of a world wheat famine was well exemplified in the case of Australia. The important applications of science mentioned in Part I—the invention of Ridley's stripper and McKay's combined harvester, the use of superphosphate and the practice of the cultivated fallow—continued to be important factors in the development and expansion of the wheat-growing industry. There was still one serious weakness. The varieties of wheat grown in Australia were obtained chiefly from Britain and South Africa and none of them was particularly suited to the Australian environment. They were often so late in maturing that the hot dry winds of late spring and early summer caused them to wilt before the grain had filled out and most of them were susceptible to various forms of rust. A realization of this brought to light perhaps the greatest of all benefactors to the wheat-growers of Australia—William Farrer. He was the son of a small landed proprietor in the north of England and had a distinguished career at Cambridge University. Fortunately for Australia he came here in 1870 for health reasons, meaning ultimately to go on the land. He first took the position of tutor to the family of George Campbell of Duntroon station, near

Canberra, partly with the idea of getting to know something of local conditions. After spending five years at this and other stations he qualified as a surveyor and was employed by the lands department to do survey work in a number of districts, some of which were in the wheat belt. During this period he became intimately acquainted with many of the problems of the man on the land, being particularly impressed by the damage caused by rust. In 1896 he retired and settled down on a small property at Lambrigg in what is now Australian Capital Territory. Although it was not a typical wheat-growing district he immediately undertook the self-appointed task of trying to produce improved varieties. In a little three-acre paddock he sowed small plots of different varieties of wheat which he had collected from all the Australian Colonies, and from Canada, the United States and India, paying particular attention to those which had a reputation for rust-resistance. For the first three years he confined himself to close observation of the varieties and did a certain amount of selection work. He soon came to the conclusion that some new method was necessary if he were to reach his objective of producing varieties more suitable to Australia's soil and climatic conditions. He decided on cross-breeding followed by selection so that he might combine the good qualities of two or more varieties in one variety and fix these desirable qualities so that the new varieties would always breed true to them. Farrer was the first wheat breeder in Australia, and almost the first in the world, to adopt this method which has since given such fruitful results in every progressive wheat-growing country. He actually made his first cross at Lambrigg in 1889, but he was so careful in his subsequent selection work that it was not till 1900 that his first new cross-bred variety, Bobs, was released for use by the farmers of Australia. In the meantime his work had attracted the attention of the recently formed department of agriculture in New South Wales. In 1898 he was appointed wheat experimentalist to the department at the modest salary of £350 per annum. What induced Farrer to accept the position was the much wider opportunity it gave him to develop his work in typical wheat-growing districts like Cowra and Wagga Wagga and the use of a much greater area of land in which to test the yielding capacity of his new cross-breds. For nine years at Lambrigg and eight years with the department he pursued his breeding programme with enthusiasm and success. From the beginning of the century till the time of his death in 1906 he released for extended trial a number of new

varieties each year, whilst others which were not properly fixed at the time of his death were made available later.

As already indicated, Farrer was first attracted to wheat breeding by the desire to produce varieties resistant to rust, a fungous disease which almost threatened the continuance of the wheat-growing industry in the 1890s. He did produce a number of varieties which were more rust-resistant and rust-escaping than any of the older varieties. More important than that, he gave to Australian farmers varieties which were higher yielding, earlier in maturing, more drought-resistant, more bunt-resistant, stronger in the straw, easier to harvest and of better milling and baking quality. In increased yield alone his varieties added millions of pounds annually to the value of the Australian wheat harvest. His work meant even more than that. He prolonged the sowing season, made possible the extension of wheat-growing into drier districts, made the work of harvesting easier and appreciably improved the average quality of the grain for bread-making. He thus raised the whole wheat-growing industry to a higher plane.

His most popular variety was Federation, which, as the name suggests, was released for general cultivation in 1901. By 1910 more than half of the wheat area in New South Wales was sown with this variety, and it was widely grown in all the other States. It remained the most popular variety in New South Wales till about 1930, after which it gradually declined in favour. Although the quality of the grain was not much above the ordinary and it had little resistance to rust, it was drought-resistant, had a high ratio of grain to straw and was easy to harvest. Above all, it filled the bags more quickly than any other variety as the harvester went round the paddocks, the quality which chiefly accounted for its popularity with the growers. It is not given to many men to alter the appearance of a whole landscape as Farrer did with this variety, the dark-brown heads of Federation replacing the pale golden colour of most of the varieties which it supplanted.

The breeding of Federation illustrates the general methods pursued by Farrer as well as throwing light on the way in which he searched the world for his parent material. He first of all crossed improved Fife, a variety imported from Canada and noted for the quality of its grain, with an Indian variety called Etawah, which was early in maturing, short in the straw and had a reputation for drought resistance. The result of this cross was the variety Yandilla, which proved a rather indifferent yielder

although it had other good qualities. Farrer crossed it with the best yielding of the local purple-straw varieties he could find and after fixing one strain of the variable progeny of this second cross got the variety Federation. It might be represented diagrammatically thus:

Improved Fife x Etawah

Purple-straw Tuscan x Yandilla

Federation

Two other wheat breeders, contemporaries of Farrer and in close touch with him, who produced a number of varieties formerly widely grown, should be mentioned—Marshall of South Australia and Hugh Pye, a former principal of Dookie Agricultural College in Victoria.

Very few Farrer varieties are grown today and none of them extensively. Why? Because they have been displaced by still better varieties, most of which have Farrer wheats in their parentage. They have been bred by men, most of them fortunately still with us, who learned some of their technique and received a great deal of their inspiration from the pioneer wheat breeder of Australia; so that Farrer's work still lives on.

The introduction of the new Farrer wheats helped greatly in the marked advance which continued up till the 2nd year of the first world war. The British government purchased the bulk of the exportable surplus of the Australian wheat crop but unfortunately could not spare the ships to take it to where it was required. The problem of storage of the grain in Australia then became an extremely serious one. All the sheds at railway stations and sidings were soon filled to overflowing, and much of the 1915 and 1916 crops had to be stacked in the open and imperfectly covered with any available material. To add to the difficulties, 1916 was almost the wettest year on record in most parts of the wheat belt. This meant another large crop on the drier fringe, but disastrous losses from rust and crops so battered down by wind and rain in many districts that they could not be harvested. Worse than that, the exposed wheat became the prey of weevils which took a very serious toll of the moistened grain. As if that were not enough, the most serious mouse plague in Australia's history destroyed a large portion of the exposed

wheat which the weevils had left. During the next few years the seasons became progressively drier with smaller than average crops, culminating in the 1919-20 drought which was just as severe in the wheat belt as that of 1902. The acreage had declined considerably owing to the number of farmers and their sons who had volunteered for active service and the psychological effect of the deterioration of the produce of previous crops. The drought broke in June 1920, and although the sowing season was delayed, a high yield per acre resulted. The war was now over, the farmers and their sons got back to their properties and other returned soldiers were settled on the land. With a free market, satisfactory prices and reasonably good seasons, the wheat industry flourished again for nearly a decade. Then came the calamitous fall in world prices caused by the policy of self-sufficiency on the part of most European countries decreasing the demand and record yields in all wheat exporting countries in 1928 increasing the supply. In the earlier years of the century wheat was produced quite profitably in Australia at the prevailing price of 3s. 3d. to 3s. 6d. per bushel. During the first world war the British government purchased the crop at an average price of 4s. 6d. per bushel. From the end of the war up till 1928 the return to farmers was between 4s. 6d. and five shillings, but it fell to the following prices at country stations: 1929-30, 3s. 2d.; 1930-1, 1s. 7d.; 1931-2, 2s. 7d.; 1932-3, 2s. 3d.; 1933-4, 2s. 2d.; 1934-5, 2s. 6d.; 1935-6, 3s. 1d. A wheat commission set up in 1934, after a thorough investigation, estimated the average cost of production at about three shillings per bushel at country stations, so that if the farmers had received no assistance they would have been producing at a loss in five of these seven seasons and just about breaking even in the remaining two. A small subsidy by the government on each bushel produced and the devaluation of the Australian currency helped to tide most of the growers over this critical period. Some relief came in 1936-7, when, owing to poor crops on the American continent, the price rose to 4s. 8d. per bushel, but it declined again to the second lowest figure on record, namely 1s. 9½d. in 1938-9, when the subsidy had to be renewed. The price prospect looked extremely gloomy when the second world war broke out. The Commonwealth government purchased all Australian wheat at prices which averaged 3s. 11¼d. per bushel for local consumption, although this was considerably below its export value.

The second world war upset the wheat-growers even more than the first world war, as it resulted in a serious shortage of super-

phosphate as well as of agricultural implements, tractors and spare parts. The area devoted to the crop had to be restricted by law on that account, farmers only being permitted to cultivate a varying percentage of their basic acreage. The area under wheat for grain actually fell from a pre-war average of about fourteen million acres to under eight million acres in 1943. It increased to thirteen million acres in 1946 but fell again to $10\frac{1}{2}$ million in 1951, largely owing to the exceptionally high prices of wool, which enabled farmers to obtain a better income from sheep with less exertion, and to legislation which prevented wheat-growers from getting as high a price for their product as they could have obtained on an open market.

The decline in acreage in recent years is by no means an unmixed evil, since it has caused the withdrawal of wheat-growing from some marginal areas and has brought about a lengthening of the rotation in many districts, with resultant improvement in the structure and fertility of the soil and the lessening of the danger from erosion. In all the wheat-growing States there had been a tendency to cultivate the land too much and to grow wheat and oats for grain too frequently, thus using up too rapidly the organic matter and humus in the soil. These are important factors in keeping the soil in such a state that the rainfall is readily absorbed. Their depletion caused a serious deterioration in the texture of the soil, encouraging run-off, ultimately producing those unsightly gullies which disfigure large areas of our wheat country. Laying down land to pasture, preferably containing a legume like lucerne or subterranean clover, not only provides nutritious food for sheep but helps to maintain both the nitrogen content and crumb-structure of the soil.

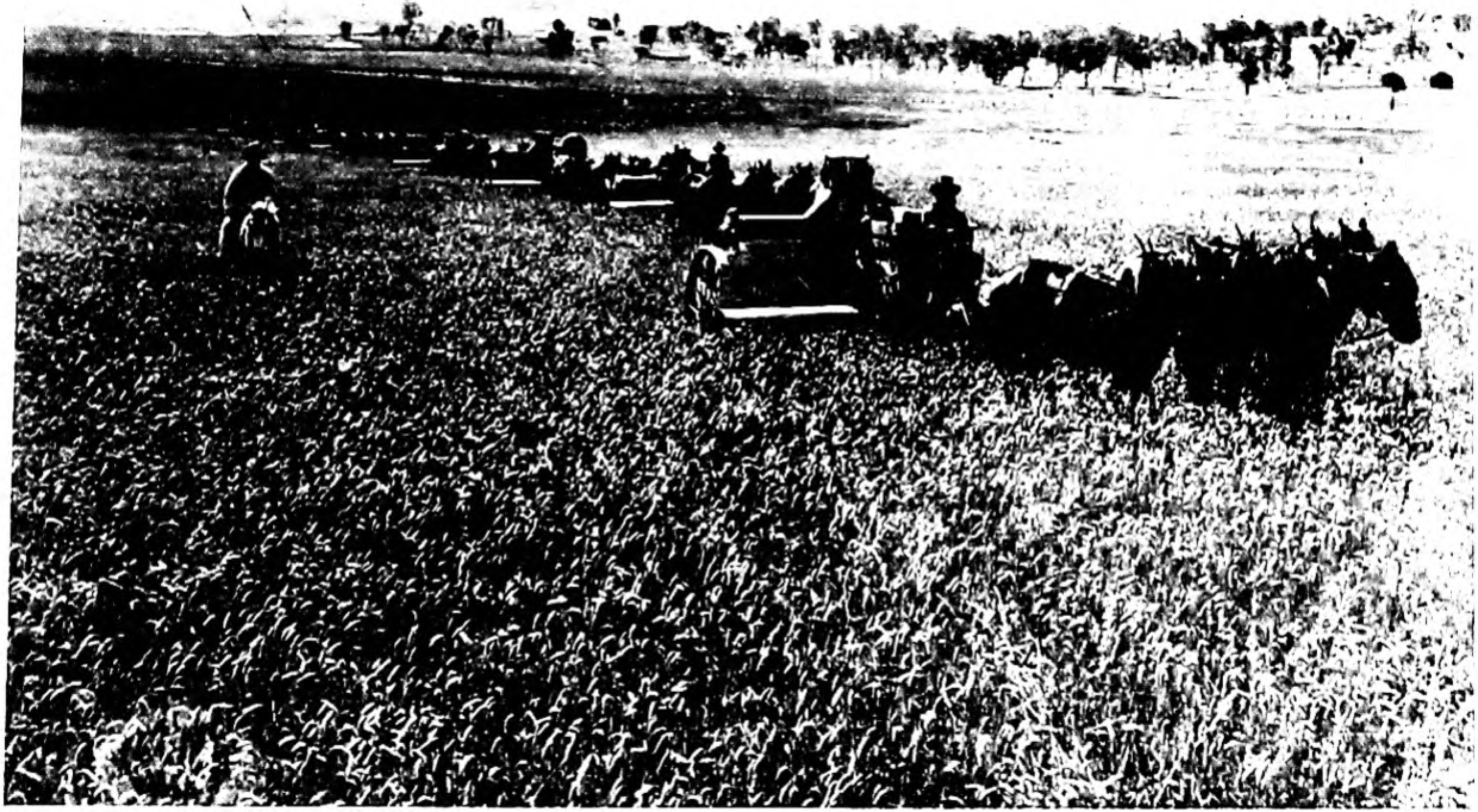
As compared with most European countries, wheat-growing in Australia is carried out on an extensive scale, profits depending on the cultivation of a large acreage rather than on high average yields. It has therefore necessitated the use of labour-saving devices of various kinds. In the first twenty years or so of the present century the size of the horse-teams and the width of the ploughs, harrows, cultivators and harvesting machinery gradually increased. The common European practice of using a pair of horses in a single-furrow plough had to be exchanged for teams of four, six, eight, ten or even twelve horses ploughing to a shallower depth with multiple-furrow ploughs, so that one man, with a longer season for the preparation of the land and the sowing of the crop, could deal with about ten times the area cultivated by the European wheat-grower. After the first world

war a new device crept into the routine in Australia as in other progressive countries, namely, the use of the tractor, which gradually supplanted horses on the majority of our wheat farms. This has enabled still larger areas to be worked by one man with still larger implements. The tractor has the further advantage over horse-teams that it can be worked at a faster rate, night and day if necessary, so that the different operations of cultivation, seeding and harvesting can be carried out at the best time for each. At the beginning of the century wheat and other cereal crops were usually sown by hand on the ploughed land and the seed covered over with the harrow. The use of the seed-drill has meant more even distribution of the seed, although it may not cover the ground so quickly as sowing by hand. It has the advantage that it necessitates a more thorough and careful preparation of the seed-bed, which in itself results in better crops. An Australian invention early in the century brought about a further improvement, enabling the seed and fertilizer to be sown at the same time in the best place for each. This has now been largely replaced by another Australian invention, known as the combine, which gives the final cultivation to the land as well as sowing the seed and superphosphate in the same rows in one operation. The design of modern ploughs, cultivators and harrows has also been improved by local manufacturers.

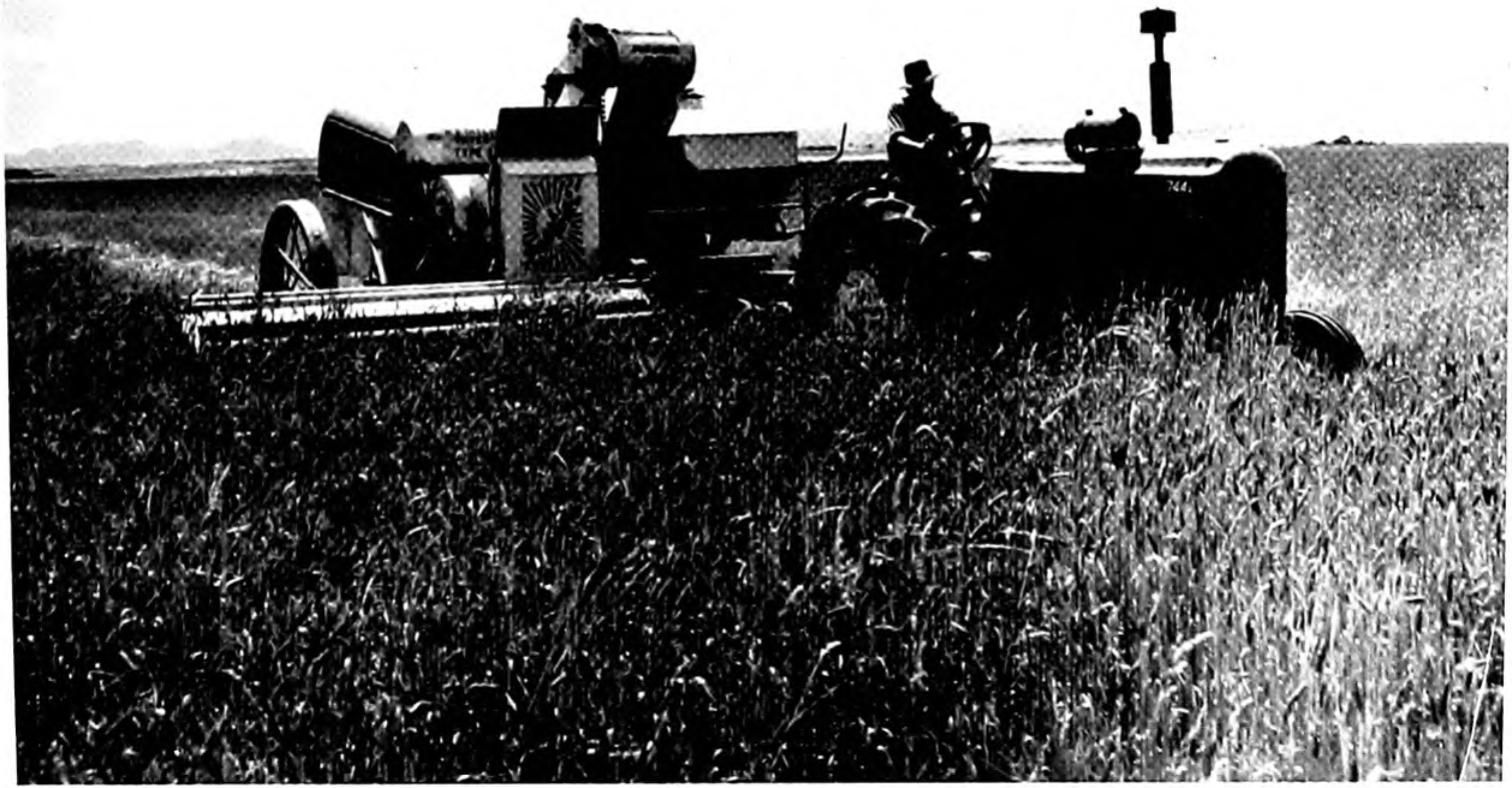
The McKay type of harvester, which was the favourite at the beginning of the century, has been gradually replaced by the header or reaper thresher, which cuts off the heads instead of beating them off and has several advantages, such as being able to deal satisfactorily with a badly laid crop or a crop not so dead-ripe, and spilling less grain on the ground. Such a header with a wide comb and pulled by a tractor is capable of harvesting the crop at a rate which would have seemed incredible at the time of federation. It is claimed that the auto header, which has the tractor and header all in one piece, will remove the heads, thresh them and bag the wheat at the rate of a bag per minute. All this modern machinery involves a large expenditure of capital and is justified only when putting in extensive areas each year.

Most of the States now have facilities for the bulk handling of the grain after it is harvested. This not only saves the use of bags but greatly simplifies and expedites the loading of railway trucks and ships.

In spite of the extension of wheat-growing into drier districts in the first forty years of the century and the severe disabilities



HORSE-DRAWN STRIPPER HARVESTERS



TRACTOR-DRAWN HEADER OR REAPER-THRESHER

suffered by the growers during two world wars it is pleasing to note that the average yield has increased by about a bushel per acre each decade, the actual figures being as follows:

	Average yield per acre
1901-10	9.82
1911-20	10.69
1921-30	11.99
1931-40	12.54
1941-50	13.84

The yield in the five years since the end of the war has actually averaged sixteen bushels per acre, which is very creditable when allowance is made for the climatic conditions experienced and the extensive methods employed by the Australian wheat-grower.

Even sixteen bushels per acre is little more than half the yield in the United Kingdom and some continental countries where the rainfall is very reliable and intensive methods of cultivation are practised. In Australia the production of wheat per man engaged in the industry is the highest of any country in the world. Many of the wheat-growing properties in the Commonwealth are one-man, or two-men farms with a little additional help at harvest time. On a farm of 1000 acres the owner, often with the assistance of a son or brother, will be responsible for all the major operations of cultivating, seeding and harvesting 300 acres of wheat, besides engaging in fat-lamb raising or some other sideline.

There are a few cases of farmers who have gone in for wheat-growing on quite an extensive scale. The most notable example is perhaps E. F. Smart of Erragulla Springs station in Western Australia, who in 1950 produced more than 300,000 bushels of wheat from 15,000 acres and who is probably the largest wheat-grower in the world today. The most remarkable facts about his achievement are that he started as a share-farmer at the age of 23, with a very small capital only 15 years before and that much of the land cropped is sand plain country, which was considered too poor to grow wheat until he tackled it, using the most up-to-date machinery and taking full advantage of knowledge acquired as the result of scientific research.

At the beginning of the century a large proportion of the farmers in the wheat belt devoted the bulk of their energies to the growth of wheat and oats for grain and hay. As previously indicated, there has been a very desirable move towards more diversified farming in which animal husbandry is playing an

increasingly important part. The wheaten and oaten hay and oat grain previously grown for the working horses can now be conserved to tide sheep, and in a few cases cattle, over drought periods. When it was realized that many large properties used solely for grazing could give higher returns from agriculture or mixed farming, the owners had two alternatives, for as a rule they did not care to engage in wheat-growing themselves, as they considered it beneath their dignity. They could subdivide their properties and sell the whole or part of them at their higher agricultural value; indeed many of them were purchased by the government and subdivided as wheat farms for either returned soldiers or civilians. The other alternative was to let part of their properties to share-farmers. One of the pioneers of the latter system was G. H. Greene of Iandra, near Grenfell, New South Wales, who at one time had about 25,000 acres let to share-farmers. The conditions vary somewhat, but a usual custom is for the owner to supply the land ready for the plough, the seed and half the fertilizer, while the share-farmer supplies the horses and implements, labour and the other half of the fertilizer, the crop being divided equally between the two. In order to encourage good farming the share-farmer is frequently given a bonus of all the grain over twenty bushels per acre. If the yield exceeds 25 bushels that excess is again equally divided. There are usually conditions attached to ensure moderately good and safe farming. On the whole the share-farming system has worked very well in connection with wheat-growing in the Commonwealth. It has enabled many men to increase their capital and experience and ultimately to purchase a property of their own.

If the production of a maximum quantity of wheat were the only consideration, the area under this crop could be increased considerably, but in many cases it would be better for our wheat-growers to concentrate on obtaining higher yields per acre with a lengthened rotation and a second source of income from fat lambs and wool, thus maintaining the fertility of the soil and ensuring a more permanent agricultural system. Fortunately this desirable change is taking place fairly rapidly, the high price of wool proving an added incentive.

Wheat as a crop is comparatively free from insect pests, although in some seasons army worms and grasshoppers (locusts) take a heavy toll. It is subject to a number of fungous diseases popularly known as smuts and rusts, as well as to a malady significantly designated "take all". Investigation has shown that more than one fungus is responsible for the latter, although the

commonest is *Ophiobolus graminis.* This caused a great deal of devastation for a number of years but has now been largely eradicated by fallowing and rotation of crops. The organism does not attack oats, so that it can readily be starved out with clean cultivation and a modern system of rotation.

The various smuts are characterized by the production of black spores and are of frequent occurrence on all members of the family of plants to which cereals and grasses belong. Two species, flag smut and bunt or stinking smut, have in the past greatly reduced the yield of wheat in certain seasons and districts. In some seasons flag smut has caused more damage than rust, but the production and widespread use of resistant varieties has reduced its incidence almost to vanishing point. Bunt has been a source of trouble to wheat-growers from the earliest times. As the main source of infection consists of spores which adhere to the grain, the remedy lies in treating the seed wheat with fungicides. In the early years of the century the commonest of these were a solution of copper sulphate and liquid carbon bisulphide, and treatment of the grain with either of them before sowing was reasonably effective in preventing the disease. Dipping and subsequent drying were rather clumsy operations and unfortunately, especially if not used in the correct proportions, they frequently had a bad effect on the germination of the wheat. This was particularly true if the treated seed wheat had to be kept for some time before sowing, which could quite easily happen by a delay in sowing due to climatic conditions. Experiments carried out by Dr Darnell Smith in New South Wales showed that if the grain is thoroughly mixed with dry powdered copper carbonate this method has all the advantages and none of the disadvantages of the wet treatment. In the early twenties this gradually became the practice in Australia, and it has had an undoubted effect in increasing average yields. It was the first instance on record of the successful use of a dry powder as a preventive of bunt, and its use soon spread to the United States, Canada and other wheat-growing countries and paved the way for the use of other fungicides applied in the form of a powder with great benefit to the wheat-growing industry throughout the world. Another method of combating this plant disease is the breeding of bunt-resistant varieties, and this is one respect in which some of the Farrer varieties were pre-eminent.

The various rusts of wheat are of more widespread occurrence than the smuts, and the losses they cause are frequently more

devastating. We have already seen that they drove the wheat-growing industry away from the coastal districts of New South Wales in the early days. They still cause alarming losses amounting to millions of pounds in Australia when warm humid conditions occur at a critical stage in the growth of the crop. As the spores of the fungus are air-borne, treatment of the seed is quite useless and it is not easy to spray effectively the large areas usually devoted to wheat. Distribution of sprays and dusts by aeroplanes has been tried with some success in Canada and the United States, but the method is expensive. It has long been realized that the greatest hope lies in the production of rust-resistant varieties, but the attainment of this objective has proved a particularly elusive one. There are a great many species of the rust fungus, but only two of them are at all serious on wheat in Australia, known popularly as leaf rust and stem rust. Stem rust is by far the more important of the two and it has naturally received most attention from our plant breeders. The main difficulty arises from the fact that although there is only a single species, *Puccinia graminis*, there are quite a number of biologic forms of this fungus which cannot be distinguished from one another under the microscope. Nevertheless, a variety may be completely resistant to one of these forms and yet susceptible to another. By using a complex technique the various biologic forms of stem rust in Australia have been definitely identified and a breeding programme arranged with the object of getting a new variety or varieties resistant to all of them and at the same time possessing other good qualities like high yield, drought resistance and good quality grain. Dr W. L. Waterhouse at the University of Sydney has spent a period of thirty years in an intensive study of the problem with quite remarkable tenacity and persistence and more than once has appeared to have reached his goal when a new biologic form of rust capable of infecting his latest creation has suddenly made its appearance. He then has to introduce a new cross with a variety which is quite immune to the latest arrival in the hope of attaining complete resistance. Other plant breeders, while not going into the fundamental problem so intensively, have had similar experiences. Although the aim of producing varieties resistant to every form of rust combined with all other desirable qualities has not yet been fully attained, new varieties have been produced in all the States which are an improvement on the best of the Farrer varieties from the point of view of yield, disease resistance and quality of grain. The

increase in the average yield of wheat which has gone on progressively in spite of soil erosion and obvious decrease in soil fertility in many regions, is in no small measure due to our plant breeders, and the wheat farmers of Australia owe them an immense debt of gratitude.

CHAPTER XXIX

The Rise of the Sugar Industry

WHILST wheat-growing has proved the most suitable and popular agricultural industry in the semi-arid and sub-humid districts of southern Australia some distance from the sea, the growth of sugar-cane has performed a similar function in the humid subtropical and tropical coastal districts farther north. For best results sugar-cane requires a deep, rich, well-drained soil with a heavy rainfall, relatively high temperatures and freedom from severe frosts. Such conditions prevail on the alluvial soils and rainforest lands in the north-eastern corner of New South Wales, and especially at intervals along the Queensland coast. There has not been much advance in cane-growing in the former State since the beginning of the century, and the industry is now practically confined to the alluvial flats along the Tweed, Richmond and Clarence rivers, where the cane can be conveniently transferred by barge to the three mills run by the Colonial Sugar Refining Company. In Queensland, which now produces about 95 per cent of the total crop, progress has been phenomenal, and attention will be mainly confined to the industry as practised in the northern State.

We have already seen that attempts were made to grow sugarcane on the Hastings River as early as 1822 but that there is no record of the successful growth of the crop in New South Wales till 1864, when a small area was harvested on the Clarence River.

Just before this a few acres were grown near Brisbane and the sugar was extracted from it. It is on record that a committee appointed by the young Queensland government recommended that a free grant of 500 acres of land be made to John Buhot in 1862 as the producer of the first granulated sugar in Queensland from sugar-cane grown in the Colony. This was a notable achievement, but the quantity involved was small and the credit for initiating the sugar-cane industry in Queensland is usually given to Captain Louis Hope, who had twenty acres under the crop on his property near Brisbane in 1863 and who afterwards

erected a mill for the extraction of the sugar. The more important part he played is indicated by the extent of the free grant allotted to him, 2560 acres. For a year or two cane-growing was confined to the neighbourhood of Brisbane, and by 1867 some 2000 acres were under the crop, and 168 tons of sugar were manufactured in spite of a good deal of damage by frost. It very soon spread north into more suitable latitudes, and by 1872 a start had been made at Bundaberg and over 3000 acres were under cane in the Mackay district, where the first mill was erected in 1868. Enterprising settlers carried the industry still farther north to the Herbert and Johnstone rivers and later to the neighbourhood of Cairns. This expansion was undoubtedly greatly assisted by the importation of coloured labour from the South Sea islands. The first eighty Kanakas arrived in Brisbane as early as 1863, and by 1868 their number had increased to 1000. In that year the first of a series of Acts was passed to ensure for them proper treatment and protection. Before the passing of this Act there had been some abuses, but the majority of the Kanakas appeared to be quite happy in their work, and all of them put on weight and improved in physical condition as the result of a more generous diet than they had been accustomed to in their native islands. It is worthy of note that many who had been repatriated expressed a desire to return to Australia.

With cheap labour and cheap land the industry gradually expanded along a great stretch of the coast-line, and by 1878 Queensland was producing about one-sixth of the sugar requirements of the whole of Australia in spite of the highest *per capita* consumption of any country in the world. The mills available for crushing the cane at this time were small and inefficient by modern standards. Many of the larger growers had their own mills and frequently bought and crushed the cane of neighbouring farmers. Altogether 68 mills were actually in operation in 1878, more than twice the number operating at the present time.

In the eighties a great fillip was given to the sugar industry in Queensland by the activities of the Colonial Sugar Refining Company, which acquired a considerable area of land for the growth of the cane, and erected larger, more efficient mills for the extraction of the raw sugar, which was consigned to their refineries in Sydney for final treatment. By 1888 the company was harvesting 5000 acres of its own cane and had a total investment of £624,000 in Queensland, of which more than one-third consisted of mills and treatment plant. By 1890 the total area under cane had increased to about 69,000 acres. A special feature

of the nineties was the elimination of the small mills on individual properties and their replacement by much larger and more up-to-date central mills in all the leading sugar districts. Instead of about fifty planters in a particular locality each owning a mill and employing about sixty Kanakas, about 800 small farmers each employing four Kanakas took their place and had the sugar extracted at a larger, more up-to-date mill.

The first varieties of cane introduced into Queensland came from Java and Mauritius, and they were not necessarily ideal for Australian conditions. New Guinea is particularly rich in native varieties of cane, and several expeditions, not only from Australia but from the United States and other countries, have been sent there from time to time in search of more disease-resistant and better yielding strains. In 1895 Henry Tryon, a scientific officer of the Queensland department of agriculture, was commissioned to proceed to New Guinea to collect promising varieties of sugar-cane, which were sent to State nurseries in Queensland as well as to the department of agriculture in New South Wales. He actually brought back with him 66 varieties, including Badila, one of the most useful canes ever introduced into Australia. It was particularly suited to the northern districts, which at one time had as much as 95 per cent of their total area under this variety, although it took some time for its value to be realized and for cuttings to be available to plant any considerable acreage. In the nineties, too, the cane-growers were beset by many troubles. There was an obvious decline in soil fertility and production in some of the areas which had been under crop for a considerable time, and plant diseases and insect pests were taking an increasing toll. It became more and more obvious that the sugar industry required scientific research and guidance, which the department of agriculture and stock was not in a position to supply. It was therefore decided that Dr Walter Maxwell, director of the leading sugar experiment station in Hawaii, should be invited to visit Australia and report on the requirements of the industry. His report was presented to the Queensland government in January 1900, and before the end of the year the Sugar Experiment Station Act was passed. This led to the creation of the bureau of sugar experiment stations which has been of immense value in improving the status and productivity of the industry up to the present day.

Ever since its inception, the bureau has been largely supported by the industry itself and only partly by the government. The Act of 1900 provided for the levying of a small sum for every

ton of sugar delivered at the mill, the assessment being paid by the grower and mill-owner in equal proportions. The government of Queensland subsidized this annual amount on a £-for-£ basis up till 1934, when the amount of the government subsidy was limited to £7000 in any one year. As the total expenditure of the bureau gradually increased to over £45,000 in 1948-9 it will be seen that much the greater burden (85 per cent) falls on the sugar industry, and yet it is no great hardship, as it only amounted in the latter year to 0.2 per cent of the total production of sugar in Queensland. As will be seen presently, the bureau has proved a most profitable investment on the part of the growers and millers and their experience should act as an incentive to other industries to follow in their footsteps, as has recently been done by the wool-growers. Dr Walter Maxwell was appointed the first director at a high salary in 1900, and he immediately commenced the establishment of three experiment stations at Mulgrave, Mackay and Bundaberg. It was decided that the latter should be the headquarters of the director and his scientific staff, and in August of the following year (1901) the main laboratory was duly opened.

The foundation of the bureau was not the only event which had a marked effect on sugar production at the turn of the century. The industry, especially in the north, had become very dependent on Pacific islands labourers, although the proportion of white people employed had been gradually increasing. Between 1885 and 1900 the area under sugar-cane in Queensland more than doubled, whereas the number of Kanakas employed decreased by 2000. Nevertheless, the white Australia policy agreed to at the time of federation could not be put into force immediately without causing serious inconvenience. A system of tapering off had to be devised, and the final arrangement made by the new Commonwealth government was to the effect that no Pacific islands labourer should enter Australia after 31st March 1904, and that none should enter without a licence. During 1902 the entries were restricted to three-quarters of the number who returned to their native islands in 1901, and during 1903 to not more than half of those who had entered in 1902. If any Pacific islanders were found after the end of 1906 they were to be deported. A later Act was passed making a few exceptions to this rule, but it may be said that the sugar industry has practically been run by white people since 1907. As far as the growers were concerned, the change-over was cushioned by the granting of a bounty of six shillings to 7s. 6d. per ton on cane produced en-

tirely by white labour. In spite of many predictions to the contrary, the industry continued to make progress, and by 1910—a good season—the yield of raw sugar first exceeded 200,0000 tons. It had a set-back in the following year owing to a prolonged strike of sugar workers for higher wages and better conditions, mainly for mill workers, and a good deal of the crop was left standing in the fields. In 1912 another expedition was sent to New Guinea in search of new canes, but none were found good enough to replace the best of those secured by Tryon. In spite of much damage by floods in some of the northern cane-fields, the total production in that year created a new record of 243,000 tons. The outbreak of the European war in 1914 caused a set-back as the large number of voluntary enlistments depleted the available labour. Then, in 1915, there was an acute drought in the southern cane-fields, and much of the crop was used for fodder purposes, with the result that the production fell to 140,500 tons. Costs of production were on the increase, heightened by the Dickson award of 1916, which caused the closing down for a period of a number of mills. The result was that a large crop of stand-over cane had to be crushed in 1917—an exceptionally good season—with another record in production of 307,000 tons of sugar.

A series of very severe cyclonic disturbances in 1918 caused great damage to mills as well as to crops and even resulted in the loss of several lives. A further set-back occurred in 1919 in the form of another severe drought, which was again most acute in the southern districts. To add to the difficulties of the war period there was a serious shortage of some of the fertilizers which were essential for the satisfactory production of the sugar-cane crop. Another serious grievance of both the growers and the millers was that the price of raw sugar had not increased in proportion to the rise in cost of production, or even to the general rise in the world price of sugar. In 1915 an agreement between the Commonwealth and Queensland governments was made by which the price of raw sugar for local consumption was fixed, and with amendments this has been in force right up to the present day. The fixed price for the years 1915 and 1916 was £18 per ton, which was increased to £21 per ton for the years 1917, 1918 and 1919. All things considered, the price was still too low for both the growers and the millers, and a great impetus was given to the industry when the price was raised to £30 6s. 8d. per ton for the next three years. Of this rather striking increase £5 6s. 8d. went to the growers, and £4 to the millers. Enthusiasm now

reigned throughout the industry. The mills escaped from their financial difficulties and were able to instal new machinery and increase their crushing capacity. The Queensland government itself erected a very large up-to-date mill on the Tully River, which enabled new cane-fields to arise on land formerly occupied by jungle. The number of tons of cane crushed in Queensland went up from two million in 1923 to three million in 1924, and the quantity of sugar produced from 269,000 tons to 409,000 tons. This created an entirely new situation, as the crop of 1924 exceeded Australia's requirements, and 74,000 tons had to be exported at the world price, which had now fallen below the new price fixed for local consumption, namely £27 per ton of raw sugar. Except for 1926, which was a dry year, the sugar industry had a good run of seasons with fairly rapidly increasing production and greater quantities available for export. The return to the grower in each year depended on the proportion exported and was always considerably below the local fixed price, which remained at £27 per ton.

This is illustrated by the following figures:

Year	*Production of sugar tons*	*Export of sugar tons*	*Price per ton to grower*
			£ s. d.
1924	409,136	74,000	26 0 0
1925	485,585	211,000	19 10 7
1926	389,272	74,777	24 10 10
1927	485,745	152,384	22 0 4
1928	520,620	186,703	20 7 11½
1929	518,516	197,000	20 5 10
1930	516,783	203,605	19 13 1

The position was now arrived at that the greater the production, and therefore the greater the export, the lower the average return to the grower. At a conference of sugar interests in June 1929 it was agreed that there must be some limitation of production. All sugar produced by any mill beyond that of the peak year, or any sugar manufactured from cane grown on unassigned lands, was to be placed in a separate export pool, the price payable being the average price realized for all sugar exported.

The reduction in price was more than balanced by the greater production per acre of cane of higher sugar content and the efficient extraction by the more up-to-date milling plant right up to the outbreak of the second world war. Indeed, progress

during the thirties was astounding. Although the local price of raw sugar fell to £24 per ton, and the average export price to about £8 per ton, and although the retail price of refined sugar was reduced from five pence to four pence per lb., the area increased by about 40,000 acres and the production of raw sugar to over 800,000 tons, valued at nearly £13 million including about £4 million worth exported by 1938-9.

As in the case of wheat, the second world war had a much more detrimental effect on the sugar industry than that of 1914-18. The most serious drawback was the acute shortage of those fertilizers which had been increasing the yields on nearly every cane farm. This, together with a shortage of labour, machinery and spare parts, resulted in a slight reduction in the acreage and a serious fall in the yield per acre. Costs of production were mounting steadily, and the serious situation was saved by an increase in world prices. The home consumption price remained steady at £22 to £23 per ton, but the export price rose rapidly. Soon after the outbreak of the war, the British ministry of food arranged with the Queensland government for the purchase of the whole of Australia's surplus production of raw sugar at prices equivalent to £11 5s. 6d. per ton in 1940, increasing to £13 in 1943, £15 in 1944 and nearly £17 in 1945. These prices hardly compensated growers for the lower yields and increased costs. The British government, after peace was declared, continued to purchase all the exportable sugar from Australia up to the present day at a figure approximately equal to the greatly increased world prices. In 1946 the export price was almost identical with the fixed home-consumption price, and in 1947 and 1948 it exceeded it by £5 or £6 per ton. This brought about an entirely new situation, as the previous position was reversed, and the greater the production of sugar, and consequently the greater the amount exported, the higher was the average price per ton. White-grown sugar was thus for the first time in a position to compete successfully on equal terms in the world's markets not only with beet sugar but with cane sugar produced by coloured labour. It has been a tremendous triumph for those who had faith in a tropical and semi-tropical land industry carried on by white people who have successfully reared healthy families in a region where many anticipated a decline in fertility and robustness. The great majority of these successful settlers are of British stock, although there has been a considerable influx of Italians, especially in the more tropical districts. One of the many commissions appointed to inquire into the sugar industry reported

in 1930 that the percentage of aliens (chiefly Italians) employed in all branches of it was only 10.1, although it was as 23.4 in the most northerly of the three main districts.

Sir Raphael Cilento in his book, *The White Man in the Tropics*, makes these interesting comments:

> Australia has the unique distinction of having bred up during the last seventy years a large resident pure-blooded white population under tropical conditions. . . . This happy experience is directly referable to the relative absence of tropical diseases and also of a resident native race. . . . The tropical areas of Australia are unique in that they are occupied by many thousands of pure-blooded European settlers (103,000 along the coast of Queensland alone). These settlers, some of them in the second and third generation, make up altogether the largest mass of a population purely white settled in any part of the tropical world and represent a huge unconscious experiment in acclimatization.

Vital statistics show that north Queensland compares favourably with other parts of the Commonwealth in general health, expectancy of life, birth rate and low infantile mortality. The Australian medical congress in 1920 passed a resolution stating that "they were unable to find anything pointing to the existence of inherent insuperable obstacles in the way of permanent occupation of tropical Australia by a healthy indigenous white race".

The striking progress of the industry during the present century is well illustrated by the following figures, showing the production of cane and sugar per acre in five-year periods:

	Acres harvested	*Tons of cane per acre*	*Tons of sugar per acre*
1900-04	70,606	13·49	1·39
1905-09	92,197	16·01	1·76
1910-14	95,873	17·26	2·00
1915-19	95,106	17·55	2·05
1920-24	131,868	16·54	2·12
1925-30	202,618	17·25	2·36
1930-34	221,395	18·10	2·59
1934-39	247,092	20·91	3·06
1940-44	240,400	18·36	2·65
1945-49	244,554	20·53	2·86

The set-backs caused by two world wars are clearly indicated, but in spite of these the area harvested has been multiplied nearly 3½ times. More creditable than that, however, is the 55 per

cent increase in the production of cane per acre and the 105 per cent increase in the yield of sugar per acre.

Whereas at the beginning of the century it took nearly ten tons of cane to produce one ton of sugar, it now takes only seven tons. This improvement is partly due to more efficient extraction of the sugar, but largely to better varieties of cane and greater use of fertilizers and improved general technique on the part of the growers. The latest figures, now that the war disabilities have passed away, are extremely creditable, as during the last few years the production of raw sugar has exceeded 900,000 tons per annum, and the present objective is to exceed one million tons each year.

The very satisfactory progress has been partly due to the sympathetic attitude of both Commonwealth and Queensland governments, to the manifold activities of the Colonial Sugar Refining Company and to the enterprise of many progressive growers and millers like John Drysdale, the Gibson family of Bingera and the Youngs of Fairymead. No unprejudiced person would deny that the greatest factor of all has been the research and extension work carried out by the bureau of sugar experiment stations which came into existence in 1900, and has just celebrated its jubilee. Dr Maxwell's main trouble was to find a sufficient number of men with the proper scientific training to carry out the necessary research in soil analysis, plant pathology, plant breeding, entomology, mill technology, etc., and he resigned his position in 1909. The task was easier when graduates in science and agricultural science became available from the various Australian universities. Even these needed some additional training in the special problems of the sugar industry. An excellent move was therefore made in 1924 when three specially selected young graduates of the University of Queensland were sent overseas for advanced study in soils and plants nutrition, plant pathology, and mill technology. On their return they were appointed to the staff of the bureau and were able to initiate and direct investigations of a more fundamental character than had been possible before, especially as they were able to attract other university graduates to help them in their work.

The bureau has now five main divisions, namely, soils and agriculture, entomology, pathology, cane-breeding, and mill technology, all of which have made notable contributions to the progress of the industry.

Although most of the soils on which it is grown commercially are rich in plant food materials, sugar-cane is a very exhausting

crop. The common practice had been to grow a plant crop from stem cuttings and to follow this with two ratoon crops, which come up again from the old stools. Then, after a period of fallow, the land would be put under a plant crop again. Although a large proportion of the crop is built up from water and the carbon dioxide of the air, the removal of sixty tons of cane every three years takes its toll of the soil constituents. The ploughing in of a leguminous crop like cow-peas or velvet beans instead of a bare fallow was recommended by the bureau, and this helps to keep up the humus and nitrogen content of the soil. Field experiments have shown that in order to maintain fertility and keep up production, it is necessary to apply a mixed fertilizer containing varying amounts of the three main constituents, nitrogen, potash and phosphate, and occasionally lime. Such experiments have been correlated with soil analysis in the laboratory, and it is now possible for the bureau to make definite recommendations of the best mixed fertilizer to use on each particular soil type. Demonstrations are carried out on individual farms, and the extension workers of the bureau carry the desired information to the growers, who eagerly follow their advice, partly because they look on the bureau as their own organization. The practice of green manuring, together with the use of the proper fertilizer on the great majority of the cane farms, has added greatly to the production of both cane and sugar and placed the whole industry on a more permanent basis. Officers of this branch have also been helpful in minimizing the damage from soil erosion and in assisting farmers with their irrigation practice where water is available and dry seasons and districts make it necessary.

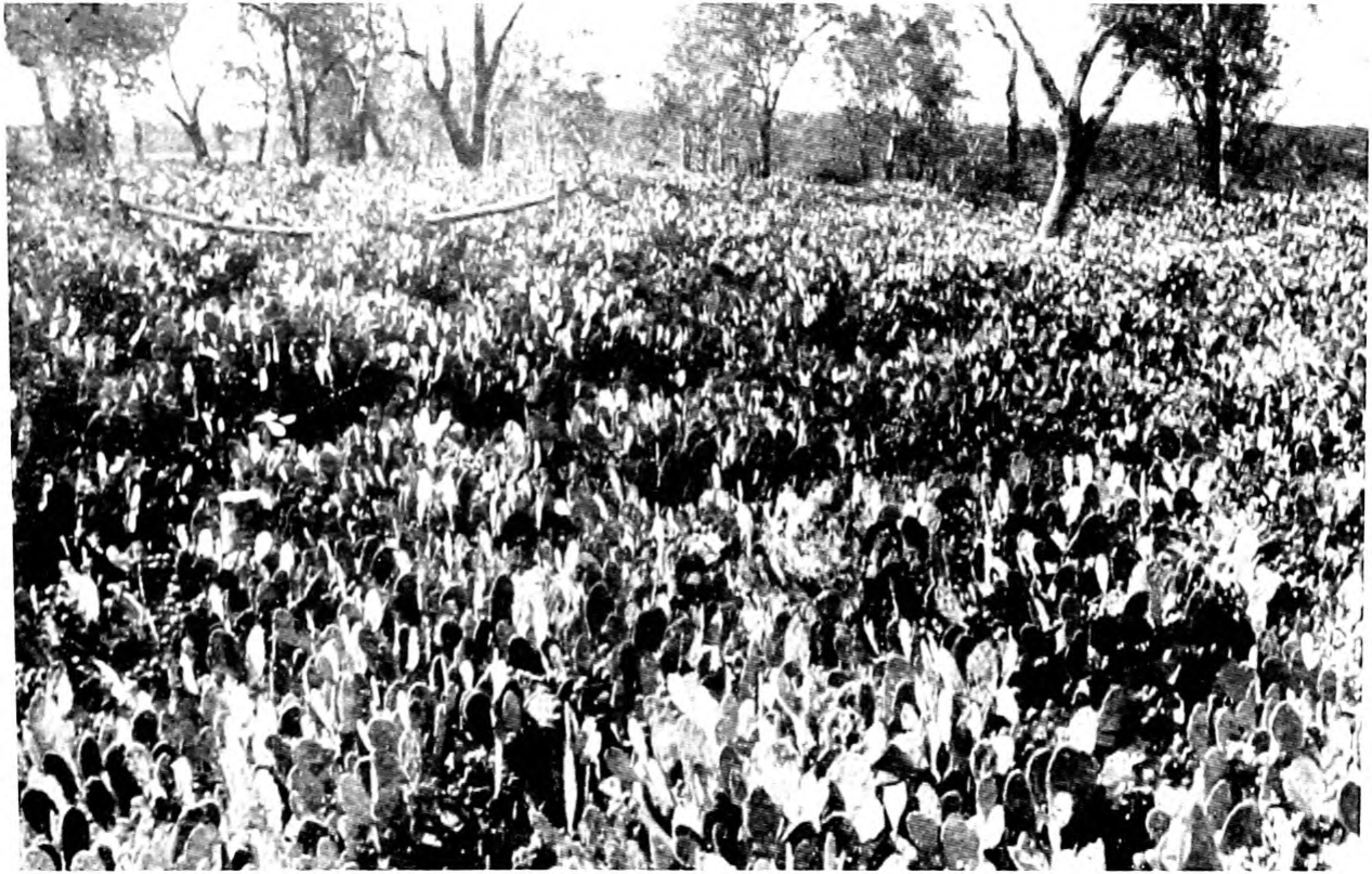
Sugar-cane is a crop which suffers greatly from various pests and diseases. Three native species of rats have caused considerable damage to standing cane from time to time, but the pest is now kept in reasonable control by the widespread use of suitable poison baits recommended by the bureau. From the earliest days one of the greatest enemies of the grower has been grubs which feed on the roots of the cane. They have frequently destroyed whole crops or rendered them hardly worth harvesting. Entomologists have studied the life histories of the various species and experimented with various methods of lessening their ravages. Collecting the grubs and mature beetles, the introduction of the giant toad, poisoning with arsenical preparations and fumigating the soil with carbon bisulphide, all gave comparatively disappointing results. In 1945, amongst a number of the newer insecti-

cides investigated, benzine hexachloride was tried and gave spectacular results. Its application at the rate of 150 lb. of ten per cent dust per acre is now the regular practice, with the result that the damage done by this insect pest has practically disappeared. It has been estimated that the savings effected by this new treatment in a single season amount to several times the money expended by the entomology division since its inception. It now seems certain that this comparatively cheap and easily applied insecticide will remain effective in the soil for three years. In poorly drained land wireworms cause almost as much damage as cane grubs and it is pleasing to relate that they can now be effectively controlled by an even smaller dressing of benzine hexachloride mixed with the fertilizer. Almost the only other serious insect pest is a species of borer, and it has now been almost completely eliminated by the burning of the trash on the cane before harvesting, which has other advantages as well.

Although damage by insect pests in the past has been serious, losses through plant diseases have been much greater. Partly because, like the potato, it is reproduced vegetatively and not from seed, sugar-cane is peculiarly subject to fungus and virus diseases. When the plant pathology division came into being in 1928 it found itself confronted by an alarming list of these diseases for which no method of control was then known. The most important were Fiji disease, gumming, leaf scald, red stripe, downy mildew, chlorotic streak and dwarf disease, although some of them were not definitely identified till a few years later. The first task of the division was to get an exact knowledge of the symptoms of the various diseases and of their occurrence and to educate the farmers in their identification. At the same time every endeavour was made to ensure that no diseased cane was used as setts, and surveys were carried out to locate disease-free farms from which such setts could be obtained. When the limits of the occurrence of the various diseases became manifest, quarantine arrangements were enforced, so that no cane for planting purposes could be transferred from a district in which, say, Fiji disease occurred to another district which was free from it. To assist in the carrying out of these regulations cane pest and disease control boards were set up in all the main sugar districts. It was clearly realized by the division that the greatest hope rested in disease-resistant varieties, which must be either imported or bred at home. It was too much to hope that a variety would be discovered that would be resistant to all of them, although some

MURRUMBIDGEE LAND BEING CLEARED FOR IRRIGATION

IRRIGATED FRUIT-TREES ON THE MURRUMBIDGEE IRRIGATION AREA



PRICKLY PEAR

might be resistant to all, or most, of the diseases found in a particular locality.

The old variety Badila, for instance, was fairly resistant to most of the diseases occurring in northern areas, but was very susceptible to chlorotic streak, and it became necessary to destroy at once all plants suffering from this disease. A large number of new varieties were imported from Java, Hawaii and other places. These had to stand a test for production, sugar content and other desirable qualities besides disease resistance. Much the best consignment came from Java, where a plant-breeding section of their famous sugar experiment station had been operating successfully for several years. Amongst them was the variety known as P.O.J.2878, which was an excellent yielder and was completely resistant to gumming disease. It immediately became popular in districts like Bundaberg, with the result that gumming disease ceased to be of any consequence there. Unfortunately, it is quite susceptible to both Fiji disease and downy mildew, and it required very careful inspection and rogueing by officers of the control board to hold these diseases in check till a new variety resistant to them was found. It did not matter much if this new variety was susceptible to gumming, as it had been practically eliminated by the almost universal use of P.O.J.2878. That example will give some idea of the complications involved, but the officers of the bureau have given such careful study to the whole question that they can now give growers definite instructions as to the varieties which should be grown in each particular locality, and any grower who cultivates any other variety is liable to a heavy fine. The final result is that none of the diseases enumerated is now the cause of any serious losses to the growers, some of whom previously saw all their labours ending in disappointment and ruin. Indeed, clean seed, quarantine regulations rigidly enforced with the full approval of the growers, the introduction and breeding of resistant canes and the compulsory planting of a limited number of varieties in each district have transformed the whole disease situation. One of the latest diseases to appear in Queensland is known as pineapple disease, and it gave much trouble for a time, but it can now be controlled by dipping the setts before planting in a solution of a mercurial compound.

Of recent years the breeding of disease-resistant varieties possessing other desirable qualities has been much more important than their importation. Some of them have been produced by scientific officers of the Colonial Sugar Refining Company,

but the majority of them by members of the staff of the bureau. Breeding new varieties of cane presents quite a number of technical difficulties, but all of these have been overcome and the striking success of some of the new locally bred varieties is another feather in the cap of the bureau. This work owes much of its success to the very close liaison between the pathology division and the cane-breeding division. As examples the variety Q28, which went into field trials in 1941, had become the leading variety in the Mackay district by 1945, and Q50, which first appeared on the approved list in 1947, was responsible for nearly 1.8 million tons of cane in 1950, and is expected to become the leading variety in the State. Altogether much more than half of the sugar-cane grown in Queensland is produced from Queensland-bred varieties, and the proportion seems certain to increase.

The success achieved in the field has been matched by increasing efficiency in the mill, where the standard approaches the best attained in other countries, and a great deal of the credit is due to the work of the bureau's division of mill technology.

CHAPTER XXX

Water Supply and Irrigation

THE greatest limiting factor in the development of the pastoral and agricultural industries in Australia is the scantiness and irregularity of the rainfall. Of its area of nearly three million square miles, 37.6 per cent has an average annual rainfall of less than ten inches; 68.4 per cent less than twenty inches; and 84.8 per cent less than thirty inches. To make matters worse, the rainfall in any particular locality may vary greatly from year to year. Thus a district with an average rainfall of fifteen inches may have twenty inches in one year and ten or less in the next.

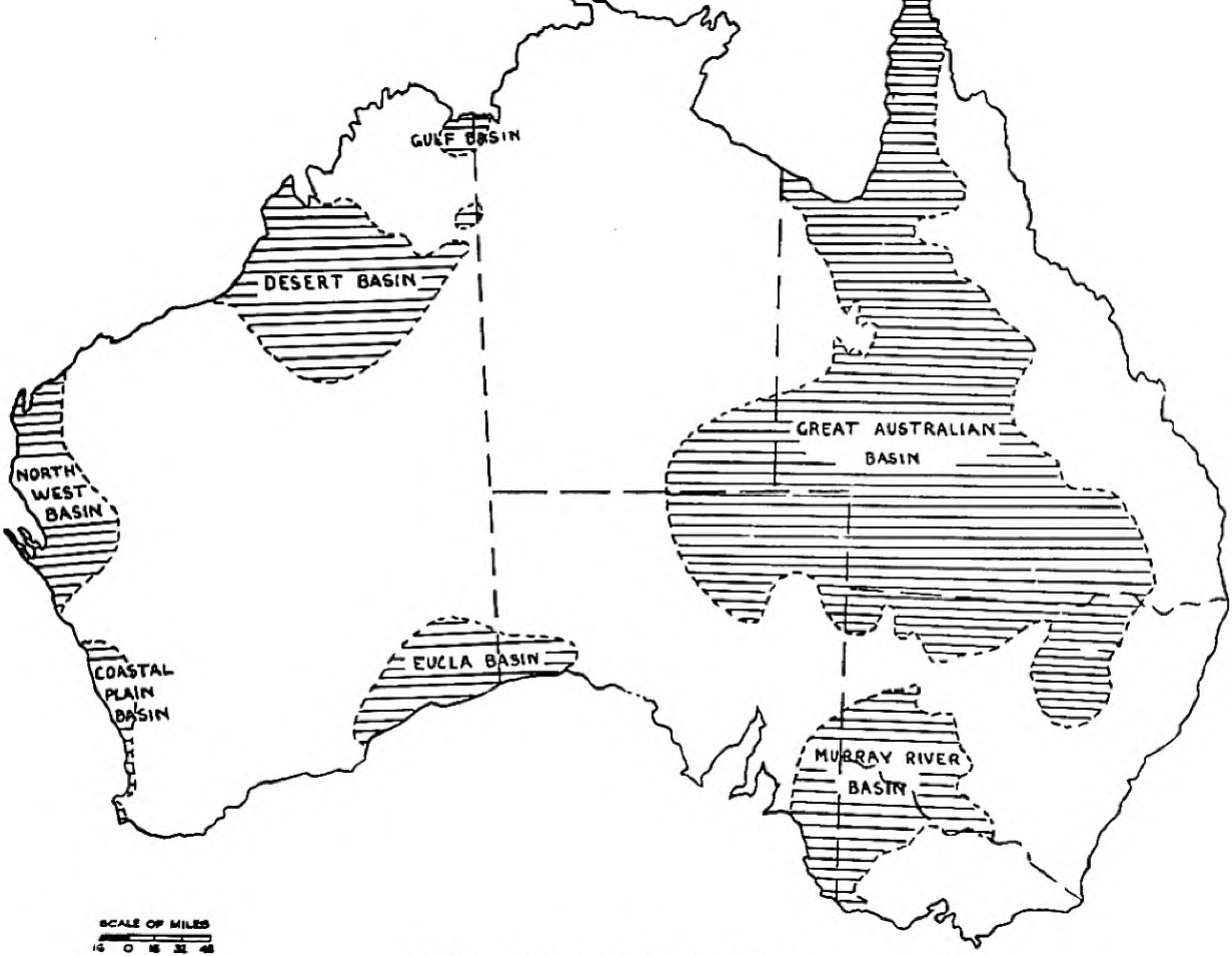
Speaking generally, the rain in the north falls almost entirely in the summer months, in the south in late autumn, winter and spring, whilst the more central districts tend to have a fairly evenly distributed rainfall. In most parts of northern Australia the bulk of the rain comes in heavy falls with a good deal of surface run-off, and a large amount is lost by evaporation. The predominantly winter rainfall in the southern districts is usually more evenly distributed and the evaporation during the active growing season is relatively low, so that a rainfall of twenty inches in the south is much more effective both for agriculture and stock-raising than a similar amount in the north. Even in the better rainfall districts there are times and seasons when irrigation would be a great advantage. It is, of course, in the lower rainfall areas that it has its most striking effects. Before any water is available for irrigation it is obvious that the requirements for domestic, stock and industrial purposes must be fully met. Where no river or creek passes through a property the chief source of water for domestic use is the run-off from the roofs of homesteads and buildings. The only water available for stock may be the result of the run-off from pastures, roads, etc. collected and stored in earthen dams or tanks.

Owing to the porous nature of the soil or the absence of a suitable catchment area, even this is sometimes impossible, and water has to be transferred from a distant source of supply like a river or lake. An excellent example of this system is the Wim-

mera-Mallee project in Victoria, which is one of the most extensive domestic and stock supply schemes in the world. The main supply is derived from a number of reservoirs at the foot of the Grampian Mountains, although it is now supplemented by water which has its origin in the Goulburn and Loddon rivers. The water is conveyed in 6600 miles of open earthen channels which carry the water to 16,000 tanks, which are filled up each winter, the objective being a year's supply for each individual property. The system serves an area of 11,000 square miles, or nearly one-eighth of the State of Victoria, including 45 towns and villages. The development of the wheat and pastoral properties in a great part of this huge area would be impossible without it.

All of the larger reservoirs on our rivers supply water for domestic and stock purposes as well as for irrigation; indeed, the former constitutes the main objective of several water storage schemes in South Australia and New South Wales.

As far as the watering of stock is concerned, large areas of the Australian continent have access to underground water—artesian, sub-artesian and well water. Indeed, the Great Artesian Basin, which underlies a large proportion of central and western Queensland and extends into adjacent parts of New South Wales, South Australia and the Northern Territory, is probably the most extensive in the world. The area involved is 550,000 square miles, of which 350,000 are in Queensland, although the first bore was actually completed at a station near Bourke in New South Wales in 1878. Since then over 3000 artesian bores have been constructed in this great basin, the depths varying from ten to 7000 feet, with a daily discharge of about 350 million gallons. Artesian water contains a considerable quantity of dissolved salts which are not, as a rule, harmful to livestock. Their presence makes the water objectionable for irrigation, even if any considerable amount could be spared for that purpose. True artesian water rises by pressure above the surface of the ground and is then generally conveyed for a considerable distance in open channels from which a high percentage is lost by evaporation and seepage. Sub-artesian water has a similar origin, being impounded in a porous stratum between two impervious layers, but the pressure is not sufficient to bring it to the surface when a bore is put down and it has to be pumped by a windmill or similar device. The multiplication of bores has caused a definite diminution of the flow in most of them and some which were formerly artesian are now sub-artesian. There seems no great danger of the supply diminishing to a dangerous extent, as the



ARTESIAN BASINS IN AUSTRALIA

underground water is being continually replenished by the rainfall on intake beds on the western slopes of the Great Dividing Range. Without this supply the pastoral industry of an immense region would be in an extremely precarious position, and it should be obvious that every possible precaution should be taken to minimize the losses from seepage and evaporation. Other extensive artesian and sub-artesian areas are to be found in the Murray River basin in north-western Victoria and adjoining parts of New South Wales and South Australia, in the Eucla Basin in south-western South Australia and south-eastern Western Australia as well as at intervals near the west coast of the latter State. Altogether something like one-third of the continent has access to artesian or sub-artesian water, and this helps to mitigate to a considerable extent the drawback of a low rainfall in vast regions of the inland.

The third type of underground water, well water, is not impounded between two layers of impervious strata and consequently does not rise to the surface. It does not contain any appreciable quantity of dissolved salts and is quite suitable for irrigation, except where it occurs in sand beds close to the sea. The most useful type is found at a comparatively shallow depth in alluvial valleys and frequently underlies rich soils which are highly productive when the rainfall is supplemented by irrigation. A good example is the Lockyer valley, to the west of Brisbane, where a heavy black alluvial soil overlies water bearing porous strata. Although the average rainfall is about thirty inches it is somewhat erratic, and best results can only be obtained when additional water is applied in dry seasons. Some 10,000 acres are now irrigated by water derived from about 500 well pumps owned by individual farmers, and a further 6000 acres by water pumped direct from Lockyer Creek and its tributaries. On this comparatively small area a considerable percentage of Queensland's potatoes, onions, pumpkins and maize is grown, besides large quantities of lucerne hay and green fodder which may be marketed direct or in the form of dairy products. Another important area irrigated from wells is in the Burdekin River delta in North Queensland, where some 30,000 acres of sugar-cane are under irrigation and provide the highest tonnage of cane sugar per acre in the State. No exact data are available about the extent of similar ground or well water areas, but probably many opportunities are being lost through ignorance of their occurrence and potential uses.

Nearly all the water at present used for irrigation purposes in

Australia is derived from rivers. At the beginning of the century irrigation was almost solely confined to a few partially developed pumping schemes along the Murray, like Mildura and Renmark, and the progress made since then has been truly remarkable. After surmounting their early difficulties, both of these settlements have gone ahead, and quite a group of others on similar lines have grown up around them. Mildura is still operated by the First Mildura Irrigation Trust, and some of the original pumping plant installed by the Chaffeys in 1890 is still operating, although it has mostly been replaced by modernized equipment discharging water at the rate of 200 cubic feet per second. This is distributed through 168 miles of channels, about half of which are concrete-lined to reduce the loss by seepage. Altogether about 13,000 acres are irrigated each year for the production of grapes, oranges, apricots, peaches, figs, almonds and olives, with a few acres under lucerne and other fodder crops. By far the most important products are raisins, sultanas and currants of which about 15,000 tons are produced each year. The town of Mildura has grown into an attractive prosperous centre, possessing many of the amenities which are frequently lacking in places of similar size. The Merbein irrigation district closely adjoins Mildura and it has developed more rapidly, as it was able to avoid some of the mistakes and profit by the experience of the pioneer settlement. A few more miles from Mildura in a different direction is Red Cliffs, which was started as a successful settlement for returned soldiers from the first world war. It has about the same area of irrigated land as Mildura and is used for the same purposes, but its production is actually considerably greater owing to higher yields per acre. It may now be regarded as the most important of all Victoria's pumping schemes, with about 700 prosperous settlers. Some distance up the Murray is the smaller irrigation settlement at Nyah, with 3800 acres in 220 holdings devoted mainly to orchards and vineyards. Across the river in New South Wales are the older settlement at Curlwaa and the newer one at Coomealla, both of which are flourishing communities with a high production from their vineyards and orchards, thanks largely to utilizing knowledge acquired at Mildura. Similarly, in South Australia the original settlement at Renmark, founded by the Chaffeys, has continued to flourish and has given rise to a number of satellite irrigation areas of which Berri, Waikerie and Cobdogla are the largest. The various products of the vine, together with oranges of the finest quality, are the principal results of the

energies of the settlers. All of them have had their troubles but are now in a flourishing condition, partly due to help received from officers of the various departments of agriculture and the field and laboratory investigations carried out at the research station at Merbein conducted by the Commonwealth scientific and industrial research organization. The land on which these thousands of successful irrigation farmers are making quite a good living on areas varying from twenty to forty acres was providing only a precarious existence for about one sheep to twenty acres before the advent of irrigation. Great honour should be given to the Chaffey brothers, who set the whole system in motion. Except for private projects on individual properties along most of our rivers and streams, pumping schemes are now quite out of date, and it is rather remarkable that those already enumerated have been able to compete successfully with those fortunate enough to have their irrigation water supplied much more cheaply by gravitation.

For all gravitation schemes it is necessary in the first place to have a large reservoir to store the excessive waters of the rainy season and of the spring flush, which frequently comes from the melting of the snow on the southern catchment area. The second requisite is to have a weir of some kind to raise the level of the river so that it may be diverted into a main canal from which it passes into subsidiary channels at a sufficiently high level to command the whole area to be irrigated.

As the Great Dividing Range runs more or less parallel to the east (and part of the south) coast and at no great distance from it, the bulk of the rivers in Australia are short and flow through country which, on the whole, has a sufficiently high rainfall for agriculture and intensive grazing. There is one notable exception, namely, the Murray River and its tributaries, the Murrumbidgee, the Darling and the Goulburn, with their tributaries. This Murray River system has a catchment area equal to about one-seventh of the whole Australian continent, and except for the first hundred miles or so of the main river, it passes through country which would benefit very greatly from irrigation.

Victoria, as we have seen, was the pioneer with regard to irrigation by pumping. It was also the first State to embark on a large gravitation scheme. This was on the Goulburn River and involved the construction of the Eildon dam with a capacity of 306,000 acre-feet, the Goulburn weir for diversion purposes and

the Waranga basin with its $4\frac{1}{2}$ miles of earthen embankment enclosing a lake 23 square miles in extent with an average depth of 31 feet. Water liberated from the Eildon reservoir flows down the river for about 150 miles to the Goulburn weir, which raises the level to such a height that it can be diverted into two canals which command a great area of irrigable land. The eastern channel supplies a number of irrigation districts in the neighbourhood of Shepparton which are largely devoted to the growth of fruit for canning. The Goulburn valley supplies enough peaches, apricots and pears to enable the local and city canneries to turn out 55 million tins a year—about seventy per cent of Australia's output. In addition to supplying one irrigation district direct, the western channel fills up the Waranga basin. From this flows a canal which, with subsidiaries, carries the life-giving irrigation water to properties over 200 miles away. Much of this water is used for the growth of crops like lucerne and to irrigate natural and sown pastures on which the fat-lamb and dairying industries flourish. The Goulburn valley irrigation scheme is still the largest single project in Victoria, with an irrigable area of 375,000 acres.

The next State to start a large gravitation scheme was New South Wales, which embarked on a still larger project although it had practically no experience of irrigation at the time of its inception. This is the Murrumbidgee irrigation scheme, an important feature of which is the large storage reservoir at Burrinjuck with a capacity of 771,640 acre-feet. It has a catchment area of 5000 square miles, including a considerable snow region in the neighbourhood of Mount Kosciusko, and when full, it forms a picturesque inland lake containing more water than Sydney Harbour. During the irrigation season from September to April the requisite amount of water is released from the dam and flows down the river, where it is supplemented by the unregulated flow from the Tumut River until it reaches the Berembed weir 240 miles downstream from the dam. Here it is diverted into the main canal, which supplies the water to subsidiary channels so arranged as to deliver the water at the highest point of each individual farm in the Yanco and Mirool irrigation areas. An ingenious Dethridge meter measures the quantity of water supplied to each settler, who can then use it at his discretion for the growth of one or more of a great variety of crops. The main canal itself is approximately 100 miles in length, and the mileage of the whole reticulation system exceeds 1200. Before the first irrigation water was made available in 1912, the land was occupied

by a few sheep stations with a small human population. It now supports about 2000 irrigation farmers with an annual production of £7 million. The original intention was that the bulk of the area would be devoted to fruit culture and viticulture, and both of these have grown into important industries. A co-operative canning factory, claimed to be the largest in the southern hemisphere, turns out each year tinned apricots, peaches, pears and vegetables to the value of well over £1 million, whilst over 6000 acres are used for citrus fruits. Grapes are used for the fresh fruit market, for drying and for wine-making. Six large wineries and a few smaller ones in the area are run by private firms who have invested over £1 million in plant.

There is a considerable area of level land which lies very conveniently for irrigation but has too heavy a soil for horticulture. On about 24,000 acres of this a prosperous rice-growing industry has developed. Wheat and oats are grown for hay and grain, yielding large crops each year, as the moisture supply is no longer a limiting factor. A considerable area is also devoted to fodder crops and to irrigated natural and sown pastures on which the fat-lamb and wool industries thrive. The wool from the small area devoted to it is now greater in volume than when the whole area was covered by natural pastures dependent entirely on the precarious rainfall. Cattle, pigs and poultry form the basis of subsidiary livestock industries. Two modern country towns, Leeton and Griffith, and several smaller villages, have grown up, and the population of the whole area now exceeds 22,000, where formerly it was probably less than 100.

In addition to the benefits enumerated, the whole project ensures a reliable water supply to several towns on or near the Murrumbidgee, and provides a dependable domestic and stock supply for many properties not actually irrigated. Advantage is taken of the fall of water at the Burrinjuck dam to generate electricity which adds greatly to the comfort and convenience of town and country residents over a wide area of the State.

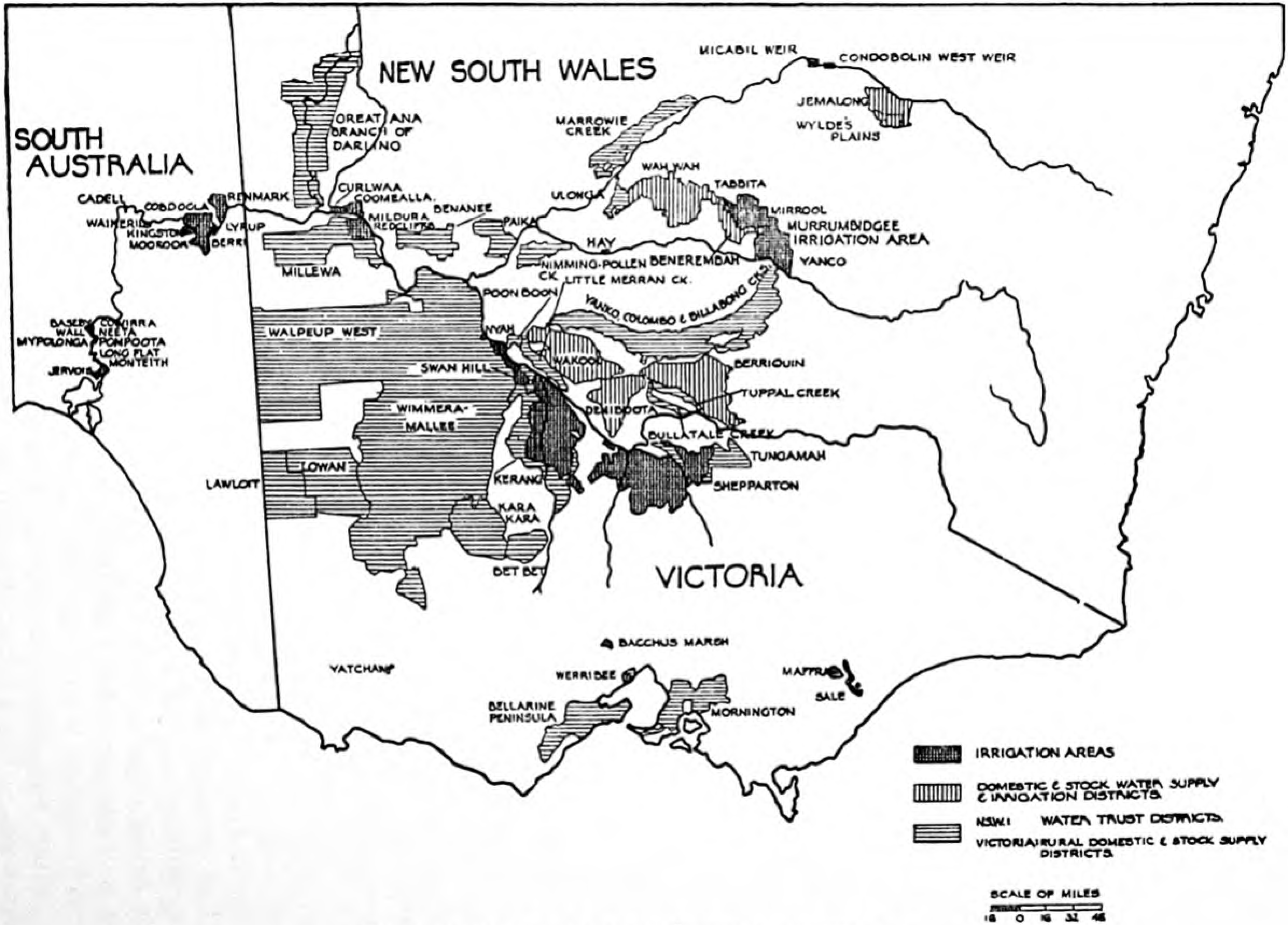
New South Wales has recently completed her second gravitation scheme by the building of the Wyangala dam on the Lachlan River. It has not such a reliable catchment area and consequently has less than half the capacity of the Burrinjuck dam. It is being used in the first place for the water supply of a number of important towns along the river and for domestic and stock supply to a great many pastoral properties. By ensuring a regular flow it makes it possible for numerous farmers and graziers with river frontages to irrigate considerable areas by in-

stalling their own pumping plants. With irrigated pastures, lucerne and other fodder crops, and with an assured water supply for stock, the carrying capacity of their properties has been markedly increased and the whole position of the owners made much more secure. A weir constructed at Jemalong enables water to be supplied to two regular irrigation districts which are in process of development.

Other water supply and irrigation projects which have been started on inland rivers in New South Wales are the Keepit dam on the Namoi River and the Burrendong dam on the Macquarie. The longest tributary of the Murray is the Darling, and it passes for its whole length through country which would benefit greatly from irrigation. Owing to the configuration of the country it is not possible to construct a reservoir of any great height to conserve the waters of its very irregular flow. It is proposed to construct about 35 small weirs along its course and to divert much of the water which passes down the river during flush periods into a series of seven dry lakes near Menindee for storage purposes. This is really a very ingenious idea, especially as it is estimated that the storage capacity will be no less than two million acre-feet. It is likely to take seven or eight years to complete the scheme, but when its subsidiary water-supply and irrigation projects are fully operating it should make a tremendous difference to this parched area of the State.

All these schemes belong to the Murray River system, and it is only recently that much thought has been given to water conservation schemes on the coastal rivers of New South Wales. The longest of these rivers flowing through the richest valley is the Hunter River and the Glenbawn dam near Scone is now in course of construction. Amongst other objectives is the reduction of the effects of flooding, which is all too common on the lower reaches. On the fertile alluvial soil along its banks a good deal of irrigation is practised at present by farmers using pumping plants for the growth of vegetables and other high-value crops. The position of all who engage in this productive form of agriculture will be greatly improved when the flow in the Hunter is better regulated as the result of this storage dam, although it will require other reservoirs on some of the tributaries before the maximum benefit in flood relief can be obtained.

Much the greatest source of water for irrigation purposes in Australia is the Murray River itself. We have already seen that quite a large number of pumping schemes along its banks had been developed in three States. In addition to that Victoria, by



IRRIGATION IN SOUTH-EASTERN AUSTRALIA

placing an ingenious type of weir in the river at Torumbarry which raises the level of the river by about sixteen feet, provides water for domestic and stock supply and irrigation over a large area. The actual extent of land irrigated as the result of this scheme was 196,000 acres in 1946-7, of which natural and sown pastures constituted the greatest proportion. The remainder was devoted to cereals, lucerne and other fodder crops, with a smaller area for vineyards, orchards and market gardens, resulting in a great increase in the value of production from this erstwhile semi-arid area.

It was early realized that nothing approaching the full value of the water from the Murray River could be achieved without the construction of a large reservoir to ensure that the maximum amount was available in the summer months when it was chiefly required. The main stumbling-block was the fact that the Murray forms the boundary between Victoria and New South Wales and afterwards flows through South Australia, so that the needs and claims of three States had to be considered. Besides, in addition to supplying water for the intensive development of the land industries, the claims of navigation on the river had to be considered. Accordingly, in 1914 authorities representing the Commonwealth and the three interested States met and drew up an agreement for the control and development of the resources of the river, and in the following year the Murray River Waters Act was endorsed by the various Parliaments. This made provision for the construction of a dam and other works, for the allocation of the water amongst the three States and for the handling of the whole project by a commission of four members. The Hume dam, the largest in the southern hemisphere, has been completed at a cost of approximately £6 million. It is situated ten miles above Albury; the length of the wall is approximately one mile; it has a total capacity of 1¼ million acre-feet and forms a lake of 33,000 acres. In order to ensure an annual flow of 1¼ million acre-feet per annum in South Australia advantage has been taken of the storage capacity of Lake Victoria in the south-west corner of New South Wales, from which there are controlled inlets and outlets to the Murray. Provided this condition is fulfilled and navigation facilities ensured to a distance of about fifty miles above Mildura, the remainder of the available water is divided equally between Victoria and New South Wales. The main diversion weir, situated at Yarrawonga, raises the river level to such an extent that water can flow by gravitation through main canals and subsidiaries over a large area of both States. It was completed

in 1939 and ever since water-supply and irrigation schemes have been developing at a fairly rapid rate on both sides of the river. In Victoria the area irrigated by water diverted by the Yarrawonga weir is already twice as great as the total area of all the pumping irrigation settlements, although a large proportion of the water is simply used by the owners of the land through which the supply passes for the irrigation of cereals, fodder crops and pastures, and very little for the growth of fruit and vegetable crops. In New South Wales water from the Murray River supplies seven irrigation districts with a total irrigated acreage which is already fifty per cent greater than the Murrumbidgee irrigation area and is continually being extended. A small acreage is utilized for the growth of rice, but the bulk of it, as in Victoria, is used by graziers and some small holders for the more intensive development of livestock industries.

South Australia has not yet undertaken any large-scale gravitation irrigation schemes but uses a large proportion of her quota for domestic and stock supply. As already mentioned, she has increased her area under pumping schemes modelled on the original successful settlement at Renmark. In this group of settlements on the upper Murray the population now exceeds 18,000, whereas it was practically negligible before the days of irrigation. On the lower reaches of the Murray, where the banks are low, about 9000 acres, chiefly consisting of reclaimed swamps, are irrigated for the growth of lucerne and improved pastures on which many small holders devote their energies mainly to dairy-farming.

There is a proposal, likely to be implemented at an early date, to raise the height of the wall of the Hume dam so as to increase its capacity from 1¼ million acre-feet to two million acre-feet, which will ultimately increase the amount of water available for irrigation and other purposes by sixty per cent.

Queensland has such a large territory with a reasonably good rainfall that she has not yet developed any large gravitation scheme. Proposals for the construction of a huge dam on the Burdekin River for gravitational irrigation have been submitted by the State government to the Commonwealth authority with a request for financial assistance. Pending this, construction on a smaller scale is being undertaken by the State irrigation commission, and some 94 farms totalling 6000 acres in area have been brought under irrigation, chiefly for tobacco-growing. Apart from that most of the irrigation carried out in Queensland is done by 4000 land-holders possessing pumps with which they raise water

from rivers or streams or from underground sources. Altogether 80,000 acres are irrigated, about half of which is used for sugar-cane. Besides the production in the Lockyer valley considerable quantities are used for the growth of vegetables and fruits in the neighbourhood of Brisbane, and smaller amounts elsewhere for tobacco, cotton and other crops.

The southern part of Western Australia is poorly supplied by rivers suitable for large storage schemes, and irrigation has made comparatively slow but steady progress. A small concrete dam was constructed on the Harvey River in 1917 with the object of growing citrus fruits. The results being disappointing, the water was used for the irrigation of pastures. This was much more successful, and the demand increased to such an extent that the dam was enlarged to several times its original size. Since then quite a number of reservoirs have been constructed, the most notable being the Collie River dam and the Stirling dam. The latter was completed in 1947 and is the largest used for irrigation purposes in Western Australia, with a capacity of 44,000 acre-feet. The total area irrigated has grown from 24,000 acres in 1935-6 to about 90,000 at the present day, mainly for pastures, but increasingly for potatoes and other vegetable crops. The Ord River in the north carries a much greater volume of water than the southern rivers, and there is under consideration at the present time a proposal to build a huge reservoir there. There can be no doubt whatever about the great advantage such a project would be to the cattle industry or to the possibility of growing tropical fruits and other crops, but whether or no it would be feasible to carry out the project is simply a matter of economics.

A considerable part of Tasmania has no need for irrigation, and no large-scale gravitation schemes are proposed for this purpose. There is a considerable amount of irrigation carried out on private properties not only for pastures but for such valuable crops as hops and certain fruits. By possessing inland lakes at relatively high altitudes Tasmania is fortunate in being able to develop hydro-electric schemes which supply her with all the power and light she requires for household and industrial purposes.

Most of the large dams on the mainland and some of the smaller ones as well make use of the fall of water to generate electricity, but, generally speaking, the potential for this purpose in Australia is low compared with most other countries. Reference has already been made to the Murray and the Murrumbidgee

possessing the most favourable catchment areas in Australia, including a large section of the southern Alps with their high rainfall and snow-clad peaks. There is another river equally fortunately situated, which flows to the east coast through country with a good rainfall and therefore in no great need of irrigation. This is the Snowy River, which is estimated to have a catchment area with a run-off of $2\frac{1}{4}$ million acre-feet per annum, of which a considerable portion is above the level of the Murray and Murrumbidgee.

It would seem a pity that no use should be made of this dependable supply, and engineers have been considering for years how best to utilize it. An elaborate scheme, into the details of which it is not proposed to enter, has been worked out and adopted for making full use of it for hydro-electric and irrigation purposes. Work has been proceeding on several aspects of it for a considerable time, following on the passing by the Commonwealth Parliament in 1949 of an Act setting up an authority to implement the agreement arrived at by the Commonwealth, Victorian and New South Wales governments. The basis of the scheme is to impound the Snowy River and one of its tributaries in a series of reservoirs and divert the water through long tunnels under the mountain ranges to supplement the flow in the Murray and Murrumbidgee rivers. The fall of over 4000 feet as the water passes through the tunnels will make possible the generation of such large quantities of electricity that the power made available will be greater than the total capacity of all coal and hydro-electric stations at present operating in Australia. More important from the agricultural point of view, it will add over two million acre-feet to the Murray and Murrumbidgee rivers, a large part of which will be available for irrigation. It is a most ambitious project, involving the construction of eight major reservoirs, sixteen power stations and 86 miles of tunnels varying in diameter from sixteen to 42 feet. The whole scheme appears to have been very well thought out, and although the cost will naturally be high and it will take several years to complete, it should be of immense value to both the primary and secondary industries. Incidentally, if war should come the scattered underground power stations would be a tremendous safeguard should the large exposed power stations near the coast be put out of action.

Irrigation has been the means of increasing the production from the land in some of our arid districts as much as a hundredfold and in others five-, ten- or twentyfold. It is obvious that the

development of such schemes should have a high priority in Australia. It should be distinctly understood that the water in our rivers available for irrigation purposes is not unlimited. The rate of flow in most of our southern rivers has been accurately gauged, but fewer data are available about some of those in the northern half of the continent. One authority has made a rough estimate of the area which could be irrigated in southern Australia when due allowance has been made for the water required for other purposes. He places it at about five million acres, or about three times the present area under irrigation. If and when the whole of the available water from our southern rivers were used for irrigation purposes, the increase in production would be very great, but even five million acres represent only about 0.25 per cent of the total land surface of the Commonwealth.

CHAPTER XXXI

Some Miracles of Science

OWING to the immense size of the Commonwealth and its thinly scattered rural population, it is apt to be confronted with problems of a magnitude not approached by older and more closely settled countries. The rabbit and the sheep blow-fly pests are excellent examples of this. It is proposed in this chapter to mention a few others and to relate how each has been successfully overcome.

The Prickly Pear Menace

The control of weeds is a normal activity of farmers and graziers in every country, but probably none of them has ever been faced with such an enormous problem as those in certain districts in Australia encountered when several species of the cactus family, popularly known as prickly pears, got out of hand and spread with alarming rapidity. One species of prickly pear was introduced from Rio de Janeiro with the first fleet with the object of growing the cochineal insect on it for the production of the most popular dyestuff of the period. It was a harmless species, probably *Opuntia monocantha,* and there is no evidence that it ever got out of hand or reached pest proportions. In later years other species of cactus were introduced by settlers as botanical curiosities, grown at first in pots and later in gardens. The first definite information about such an introduction was in the neighbourhood of Scone in New South Wales, and one can imagine the curious-looking plants being distributed to friends and neighbours by the generous but unsuspecting importer. Others must have been introduced into various districts of Queensland, where they found an even more congenial habitat.

Owing to their prolific growth and the prickles on their so-called leaves or segments, they evidently became popular as hedge plants round gardens, orchards and homesteads. Being very hardy and drought-resistant and capable of rapid reproduction by seeds as well as by segments, they soon began to spread over adjacent paddocks. As so often happens when weeds

make their first appearance, little notice was taken of them. But before very long they began to form dense clumps and to spread over larger and larger areas. By 1883 the Queensland government declared them noxious weeds, with an obligation on land-holders to eradicate them. It was easy for Queensland officials to issue such an order, but not so easy for the farmers and graziers to give effect to it, and the extension of the infected areas went on and on, and by the beginning of the century it was estimated that about ten million acres were carrying pear.

During the 1902 drought they kept green whilst the vegetation around them shrivelled up and died. They served a useful purpose in keeping many cattle alive, although these suffered much pain and injury to their mouths because of the prickles. When the drought broke the prickly pears flourished and spread more than ever, and land-holders were still faced with the hopeless task of keeping them in check by digging or poisoning, the cost of which was generally much greater than the value of the land.

It was 1912 before the Queensland government took really active steps to deal with the menace. In a very badly affected area at Chinchilla an experiment station was set up to test various methods of poisoning, and the most effective agent was found to be arsenic pentoxide. At the same time the government appointed a commission of two scientists—Dr Harvey Johnston and Henry Tryon—to visit all parts of the world where prickly pears grow, in search of insects or fungi which might help in their control. After two years of careful search they brought back with them a sucking insect related to the commercial cochineal insect and recommended the introduction of a number of others. By this time a careful botanical survey of the prickly pears which had been introduced revealed that there were at least eleven species, but that two of them, *Opuntia inermis* and *Opuntia stricta*, and especially the former, were doing most of the damage owing to the rapid rate at which they spread.

After testing it on economic plants with negative results, the wild cochineal insect was released. It was found that it caused the complete extermination of one species, *Opuntia monocantha*, which is comparatively harmless, but that it could not be induced to live on any of the really harmful species. In the meantime, nothing further was done by the Queensland government about the importation of the other insects recommended by Johnston and Tryon owing to pre-occupation with another kind of warfare.

When the Commonwealth advisory council of science and

industry was formed in 1916 the prickly pear menace was listed as one of the most pressing problems for scientific investigation. It was indeed an urgent problem, as it was estimated that the area injuriously affected by the weed in Queensland and northern New South Wales was well over twenty million acres—a greater area than that under all crops in Australia at the time. Even more serious was the observation that it appeared to be spreading at the rate of a million acres per annum. Besides, some of the earlier areas attacked had become so densely covered by the pear as to be almost impenetrable, and wherever this occurred most of the graziers gave up the unequal battle, and abandoned properties and homesteads.

Even an annual extension of a million acres must have been an underestimate, as by 1926 a more accurate survey showed that the noxious weed had taken possession of sixty million acres —an area greater than that of the United Kingdom—and was still extending very rapidly. The affected region consisted mainly of moderate to good grazing land but also included considerable areas suitable for dairying and intensive agriculture. The executive committee of the Commonwealth council soon came to the conclusion that there was only one possible solution. It realized that the prickly pear had become an extremely serious pest because we had introduced hardy plants very well suited to our climatic conditions without introducing the natural enemies which kept them in check in their native environment, and that Johnston and Tryon were on the right lines. The chairman of the executive, Sir David Masson, visited New South Wales and Queensland and got a promise that the government of each of these States would put up £2000 a year for five years if the Commonwealth gave £4000 a year for a similar period to be spent on the search for, and introduction of, insects or fungi which would attack the pear. For purposes of administration a prickly pear board was set up in 1920 on which each of the three governments was represented, but the scientific direction and inspiration came mainly from the Commonwealth council. Dr Harvey Johnston was put in charge of the campaign and he immediately proceeded to the American continent, the native habitat of all species of *Opuntia*. He renewed his search for insect enemies of the two destructive species, especially in Florida, Mexico, the West Indies and the Argentine. With the help of a few assistants he set up depots in America where the insects he collected were taken and their habits and life histories carefully observed. Great care was taken to make certain that

none of the proposed introductions would attack economic plants of any kind and that they were kept free from parasites and predators before dispatch to a quarantine and breeding station at Sherwood, near Brisbane. There they were again tested on a great variety of crop and pasture plants as well as on trees and shrubs before there was any thought of liberating them. Altogether fifty species of insects found to be feeding on members of the cactus family on the American continent were introduced, but several of them failed to acclimatize and multiply under Australian conditions. Twelve species became established and were distributed to two field stations in Queensland and one in New South Wales for further multiplication and observation before being liberated.

At least three of the earlier introductions did a great deal of harm to the pear, but their rate of spread was comparatively slow. They reduced the density of impenetrable areas, killed many seedlings and some older plants, destroyed immature fruit and had a general devitalizing effect.

In 1923 Dr Harvey Johnston relinquished his position as chief investigating officer in order to accept the position of professor of zoology in the University of Adelaide. The work which he had organized so well was taken over for short periods by J. C. Hamlin and W. B. Alexander and was continued by A. P. Dodd from 1925 until the end of the investigation.

Whilst travelling in northern Argentine in late 1924 and early 1925 Mr Dodd was much impressed by the activity of a leaf-boring moth, the caterpillars of which were very active on our two pest species of prickly pear. Johnston and Tryon had actually seen it at work in the botanic gardens at La Plata, Argentine, in 1914, but had not permission to bring it back with them. It rejoiced in the significant scientific name of *Cactoblastis cactorum*. Dodd dispatched 3000 eggs of this insect from Buenos Aires in March 1925 and the consignment reached Sherwood in May, after a ten-weeks' voyage. When the ship called at Capetown a few colonies were removed by the South African department of agriculture for the fight against their pest pear, which belonged to a different species from the two worst pears of Australia. The number of caterpillars to arrive in Brisbane was approximately 2750, and this was actually the only consignment of *Cactoblastis* introduced into the Commonwealth. It might be thought impossible that such small numbers could give rise to the progeny which was to bring about such spectacular results in Australia. But we had

been fortunate in introducing an insect which simply revelled in our climatic conditions. With a practically unlimited food supply and freedom from the natural enemies which kept it in check in the Argentine, its rate of multiplication was prodigious. The introduced caterpillars thrived on the *Opuntia inermis* and *O. stricta* supplied to them at Sherwood throughout the winter of 1925 and, after passing through the cocoon stage, in September produced moths which deposited 100,000 eggs. Some of these were retained at Sherwood and some sent to Chinchilla, and the second generation in February and March 1926 yielded 2½ million eggs—a 900-fold increase in twelve months. The bulk of the eggs was systematically distributed in the worst infected districts—nine million of them from February 1926 to March 1927.

This insect has an interesting life history. The female moth lays eggs in long chains or sticks—75 to 80 in a row—which makes them very convenient for distribution. In three to six weeks the caterpillars hatch out and immediately bore into the segments of the pear and have a feast on the succulent interior, growing in size till they are about an inch long. When well gorged and fully grown they spin silky cocoons and after three to six weeks the moths emerge and immediately start egg-laying, as they have only a few days to live. There are normally two generations in a year, the egg-laying seasons being usually September-October and January-February. The summer brood of caterpillars has a comparatively short but very active life, maturing in from four to eight weeks, but the winter brood may continue feeding for six months. Under the very favourable conditions in Australia there may even be three generations in a year.

The caterpillars eat out the interior of the pear joints or segments, tunnelling from joint to joint, leaving nothing but the papery skin or cuticle in the case of the younger segments. The older segments are not destroyed entirely but various fungal and bacterial rots complete the destruction. Caterpillars may penetrate to the small underground bulbs or even the roots of the pear and thus the clumps are entirely destroyed.

From September 1927 to March 1929, 300 million eggs were released from the central depot at Sherwood and the three field stations and sent to every district affected by the pear, but even that figure is insignificant in comparison with the natural multiplication in the field in subsequent years. As the moths do not fly any great distance, graziers and the general public took part in the distribution, even schoolboys making a little pocket money

from the sale of the eggs to land-holders. Just a year after the first distribution, the officer in charge was able to report, "*Cactoblastis* can be regarded as the most destructive insect yet introduced. It should play a major role in the control and eradication of prickly pear. . . . Plants partially destroyed by one brood have been completely killed by their descendants, the moths laying their eggs on the plants on which they had fed as caterpillars".

This prophecy proved to be true, as *Cactoblastis* spread much more quickly than the pear itself had done. By 1932, just six years after its liberation, the bulk of the prickly pear had collapsed and lay on the ground, a blackened, shrivelled, unsightly mess, and it was generally proclaimed that the battle had already been won. Very soon there was a vigorous regrowth of the pear, while the vast majority of the insects had died off as they had destroyed their means of sustenance. The residue multiplied as rapidly as previously and before very long had dealt successfully with the new plants which had grown chiefly from seed.

By about 1936 the two main pest pears had been virtually exterminated, although the prickly pear board remained in existence till 1939 in case there should be any resurgence of the pest, and thus an area greater than the United Kingdom was restored to profitable production. As one writer puts it, "The prickly pear territory has been transformed as though by magic from a wilderness to a scene of prosperous endeavour." A watchful eye is still being kept by separate organizations in the two States, and the laws against the importation, and compelling the immediate destruction, of any member of the cactus family are enforced, though not so efficiently as they should be.

An interesting sequel to the successful campaign, which is generally regarded as the most spectacular example of biological control of a pest in any part of the world, is the erection of the Cactoblastis Memorial Hall at the town of Boonarga in one of the worst affected districts.

Minor Element Deficiencies

Up till the beginning of the present century it was the accepted belief of plant physiologists that only ten chemical elements were necessary for the successful growth of plants, namely carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus, potassium, calcium, magnesium and iron. The first three and part of the fourth (indirectly) are derived from air and water and they constitute well over ninety per cent of plant tissue. The soil supplies the remainder and it is a remarkable provision of nature that,

in spite of the great variety of rocks from which the mineral portions of them are formed, no soil has ever been found which does not contain all of them. Some of them, however, may not be present in sufficient quantity in an available form for the maximum growth of crops. The three that are most likely to be deficient are nitrogen, phosphorus and potassium, and consequently compounds containing one or two or all three of them form the basis of all the common fertilizers. Lime in some form is frequently applied to the soil not so much to supply the element calcium as for its indirect benefits in correcting soil acidity, improving the texture of many soils and encouraging useful bacteria. Plants require so little iron that it is extremely rare for soils to contain an insufficient amount of that element for their requirements. Occasionally, as in the Gosford district of New South Wales, there may be too little available magnesium for fruit and vegetable crops, and good results have been obtained from the application of dolomite to the soil. Cases have been noted, in Australia and other countries, where a deficiency of sulphur may be a limiting factor in plant growth. Fortunately our most popular fertilizer, superphosphate, contains a considerable quantity of this element in addition to the phosphorus which it is designed to supply.

More thorough and careful researches during the last half-century have gradually revealed that very minute quantities of quite a number of other elements are essential for plant growth. The quantity of each present in plants is of the order of one part per million or less and their presence thus escaped the notice of the earlier research workers. These are usually designated minor elements or trace elements, and the most important of them are manganese, boron, zinc, copper and molybdenum. The complete absence or acute deficiency of one or other of these trace elements in Australian soils is of surprisingly frequent occurrence and the diagnosis of the trouble and its cure by simple and inexpensive means has added greatly to the present and potential production of quite large areas.

The first of these deficiency diseases to be identified in Australia was on certain dark-coloured soils in the neighbourhood of Mount Barker in South Australia. Oats grown in this district showed grey specks on the leaves accompanied by a stunted growth and poor yields. No fungus or other disease-producing organism was associated with the condition and workers at the Waite Institute began experimenting with the addition of some of the trace elements to the soil in pots and later in the field

They finally discovered the cause to be a deficiency of manganese and a complete cure for the trouble was the addition of a manganese salt at the rate of only 15 lb. per acre and the beneficial effect of this lasted for several years. Similar symptoms were shown by cereals growing in a few districts of Western Australia and similar treatment restored a healthy and vigorous growth. Certain citrus orchards in the New South Wales coastal districts had a mottled appearance of the leaves and a general unthriftiness which was also identified as due to a deficiency of manganese. A complete cure was obtained by the application of a small quantity of a manganese compound to the soil, supplemented by a spraying with hydrated lime. Incidentally, considerable damage is done to fruit trees in several other localities by an excess of manganese in acid soils, and the application of lime is necessary to prevent it.

The success of a soldiers' settlement at Kentucky on the northern tablelands of New South Wales was jeopardized by the rather sudden appearance of a malady of apples and pears of which no causal organism could be found. Cork-like brown spots appeared in the flesh of the fruit, sometimes extending to the surface, causing malformation and cracking and rendering the fruit unsaleable. The trouble was identified as a deficiency of boron, and a cure was effected by adding borax to the soil or using a solution of it as a spray or even injecting it into the affected trees. Other apple- and pear-growing districts on the northern and central tablelands were found to be similarly affected, although to a less extent, and the blemishes were remedied by similar means. A boron deficiency causes a great many pathological symptoms in vegetable crops in several of the States, including brown heart in turnips and swedes, and again the troubles disappear when the deficiency is remedied.

The Wimmera district in Victoria has long been known as one of the most productive wheat-growing areas in the whole of Australia. An unaccountable lack of thriftiness gradually appeared in many of the crops, which was ultimately found to be due to a deficiency of zinc in the otherwise fertile soil. An application of fifteen to twenty lb. of zinc sulphate, mixed with the usual dressing of superphosphate, restored the crop to its normal healthy appearance and high yield per acre. A deficiency of zinc has been found in wheat in Western Australia and in many fruit-growing areas in the southern States, causing mottle-leaf and die-back of citrus trees and greatly reduced yields of fruit. In the apple and stone-fruit orchards at Stanthorpe in

southern Queensland the malady takes a different form, the chief symptoms being the production of small narrow leaves and consequent reduction in yields. Even young pine-trees grown in one district of Western Australia have shown a russeting of the leaves and a dwarf growth of the whole plant through a deficiency of zinc in the soil. The addition of a small quantity of a zinc salt to the soil is an effective remedy in all cases.

The most widespread areas where minor element deficiency maladies occur are those in which copper is absent or present in insufficient amount in the soil. The trouble is particularly prevalent in the south-west districts of Western Australia, where it has been estimated that something like 5000 square miles of deep sandy soils are deficient in this element. Although it is a zone climatically well suited to the growth of subterranean clover, this valuable pasture plant makes very little growth unless a copper salt is applied to the soil. The fertilizer merchants catering for this region now mix a little copper sulphate with their superphosphate, and when the mixture is applied at a rate giving only a few pounds per acre of the copper salt the growth of the clover becomes quite normal. In the Albany district particularly the addition of copper has given quite remarkable results with potatoes and oats. In other districts wheat, barley and vegetables are almost complete failures until the copper deficiency is remedied. A case is actually on record where the wheat yield was increased from two to twenty-five bushels per acre by the addition of fifteen lb. per acre of copper sulphate. Fruit trees in the deficient areas also give very poor yields unless remedial measures are adopted. Citrus, apple- and plum-trees suffer from die-back and gumming, whilst a common symptom in figs is the mottling of the leaves. It is interesting to note that the spraying of trees with one of the commonest of the fungicides, Bordeaux mixture, remedies the defect, as it contains a high percentage of copper. An acute copper deficiency also occurs in the calcareous sands along the south-east coast of South Australia, and it is impossible to grow successful cereal crops and pastures until the lack of copper is rectified by similar methods to those used in Western Australia. There is growing evidence of this deficiency in many soil types in all the southern States; for instance the die-back and gumming in some citrus orchards in the coastal districts of New South Wales are almost certainly due to the same cause.

One of the most surprising of all the elements found to cause deficiency maladies is molybdenum, as it is one of the rarest elements in nature. Until fairly recently no one ever suspected

that it was necessary for plant growth. Nevertheless, all crops and pasture plants require a minute trace of it, and especially leguminous plants, as it seems to be necessary for the proper functioning of the bacteria which fix atmospheric nitrogen and supply it to the plant. The Adelaide workers discovered that on certain soils of the Mount Lofty Range the application of less than one pound per acre mixed with superphosphate caused a quite spectacular increase in the growth of subterranean clover. Not only was the yield greatly increased but the leaves of the clover had a rich dark-green colour instead of the insipid pale green when the pastures had no molybdenum added. It is probable that this unexpected discovery may lead to results of great significance, as there are several areas in all the States where leguminous plants like the clovers make a much poorer growth than might be expected from the general soil and climatic conditions under which they are grown. There is already evidence in several cases that a molybdenum deficiency is the cause, and this can be inexpensively remedied owing to the small quantity required. Fertilizer firms are now supplying superphosphate to which a few ounces of a molybdenum compound has been added.

Sometimes more than one of the minor elements may be present in the soil in such minute quantities that the healthy growth of crops and pastures is impossible until they are supplied. The most notable example of this is the Ninety-mile Desert in South Australia, with its two-pronged extension into the Great and Little deserts in Victoria, where the application of small quantities of copper and zinc with the usual dressing of superphosphate is already beginning to bring about a remarkable transformation. The combined area of the three deserts is well over 6 million acres. They are not deserts in the usual acceptation of that term, as they have a fairly reliable and well distributed rainfall of seventeen to twenty-two inches, which should be ample for the successful growth of wheat and sown pastures. The land is for the most part gently undulating and is covered with a sparse vegetation of heath, broom and mallee. The soils are somewhat variable and by no means rich in nitrogen and phosphates, but most of them are just as good in general fertility as many others with a similar rainfall which have been rendered productive by the use of superphosphate and subterranean clover. The stunted natural vegetation gives them a desert-like appearance and the greater part of them has not been considered worth occupying. Attempts to grow cereals have met

with failure, and when graziers have taken up land in the area the carrying capacity has been something of the order of one unthrifty sheep to twenty acres. Research workers at C.S.I.R.O. division of biochemistry and general nutrition at Adelaide, after a painstaking series of investigations carried out from 1941 to 1945, finally diagnosed the lack of fertility to be due to a deficiency of both copper and zinc. The remedy was then obvious, and in several localities in the so-called desert excellent pastures of a mixture of an early strain of subterranean clover and grasses like phalaris and perennial veldt grass have already been established with the aid of an application of two cwt. superphosphate and 7 lb. each of copper sulphate and zinc sulphate. Even these small quantities of copper and zinc are sufficient to last for several years. The soil, which is chiefly of a sandy nature with some clay in the subsoil, can be easily and cheaply cleared and cultivated. The expense of establishing a good pasture capable of carrying up to two sheep per acre is therefore not great, and it looks as if a large proportion of the three barren areas will respond to the prescribed treatment.

The experience of other districts in southern Australia would definitely indicate that when the fertility of the land has been built up by the usual superphosphate and subterranean clover combination it will be possible to grow successful crops of wheat and oats, and thus a new province is gradually being added to Australia's food-growing area. So enthusiastic are the local residents that the land is being taken up rapidly and the Ninety-mile Desert has already been re-named the Ninety-mile Plain. Perhaps the most striking evidence of faith in what the scientists have done towards the transformation of the region is that our largest insurance company, the Australian Mutual Provident Society, has taken up half a million acres in South Australia and is negotiating for a similar area in Victoria as an investment. With the aid of a large staff and modern machinery they are already busy clearing, subdividing, fencing, supplying water from underground sources, laying down pastures, building houses and sheds, and thus producing ready-made farms on a wholesale scale. The workers who have taken part in all the preparatory work are to have the first offer of leasing them and applications for employment are consequently coming in steadily. This should lead to a more rapid occupation of the redeemed deserts than would otherwise have been possible.

Domesticated animals may suffer when one or other of the minor elements is deficient in the soil, and consequently in the

pastures on which they feed. It has been found, for instance, that sheep grazing in copper-deficient country produce wool lacking in crimp and described as steely or stringy. Indeed, this may be the first symptom indicating a deficiency of this element, and it can be cured by applying copper sulphate in small quantities to the pastures. This trouble is of more concern to the owner than to the sheep itself, but if the deficiency is severe the sheep may suffer from a disease known as enzootic ataxia, as in the Gingin district to the north of Perth. Farther south, dairy cattle grazing on copper-deficient country suffer from a weakness in the legs popularly known as falling disease.

The most extraordinary case of a trace element deficiency affecting animals was brought to light by C.S.I.R.O. workers in Adelaide. There is quite an extensive area along and near the south-east coast of South Australia where sheep have long suffered from a wasting disease which was a complete puzzle to the veterinary profession. Although the pastures looked quite capable of nourishing healthy stock the majority of the sheep which reached maturity showed symptoms of anaemia, gradually lost condition and frequently died. No pathogenic organism could be discovered, and when the sheep were moved to different pastures, which sometimes looked less nutritious than those on which they had been grazing, they quickly regained normal health and vigour. A careful survey of the incidence of the malady showed that it was confined to pastures growing on calcareous sandy soils and a deficiency disease of some kind was suspected. All the minor elements which had ever been known to cause deficiency troubles in either plants or animals were administered to the sheep in the form of licks or injected into the blood stream without any response being shown. Salts of other minor elements were given in similar fashion with the rather surprising result that the administration of a very small quantity of a cobalt salt brought about a rapid and complete cure. In the whole of this coast-disease area healthy sheep and lambs can now be reared by supplying them with a lick containing cobalt (in some cases with a little copper as well) or by top-dressing the pastures with superphosphate to which a small quantity of a cobalt salt has been added. About the same time research workers in Western Australia were investigating a wasting disease of cattle and sheep in the Denmark district near Albany. The symptoms were very similar—anaemia and progressive emaciation, usually followed by death within two years of the appearance of the first

symptoms, and comparatively few calves or lambs were reared. An iron deficiency was suspected and finely ground limonite, administered in the form of a lick, proved a satisfactory remedy. After the important discovery in South Australia the matter was examined more thoroughly, when it was found that it was the small amount of cobalt contained in the limonite and not the iron which was the curative agent. The Denmark wasting disease responds to the same treatment as the coast-disease of sheep in South Australia, and thus considerable areas of land which were practically useless for the rearing of stock have become healthy grazing country.

This Australian discovery of a cobalt-deficiency disease and its cure has had important repercussions throughout the world. In a considerable area of pumice-stone country in the north island of New Zealand, cattle suffered from an ailment known as bush sickness, which had been attributed to an iron deficiency and greatly alleviated by a lick containing haematite. As in Western Australia, it was found that it was the small amount of cobalt contained in the iron mineral which brought about the cure. In other parts of New Zealand a small quantity of cobalt applied to the soil, or given as a lick, has greatly speeded up the growth and development of sheep and cattle which were not thriving. In parts of the highlands and southern uplands of Scotland sheep have suffered for centuries from what was called pining disease, and the only remedy was to remove the sheep to other pastures. When the workers there heard of the Australian experiments they suspected a similar cause for similar symptoms and they actually found that their trouble was also a cobalt deficiency, which they would never otherwise have suspected. Many areas on the continent of Europe and in both North and South America have had similar experiences, and the research workers in all these countries gratefully pay a tribute to their colleagues in Australia for putting them on the right track. The Commonwealth has benefited greatly from research work done in other countries, and it is pleasing to know that, in the discovery of a cobalt deficiency as the cause of a wasting disease of stock, Australia has made an important contribution in repayment of the debt. From the experience of the last few years it seems reasonable to expect that many other cases of minor element deficiency troubles will be found in Australia, and when these are definitely unearthed and the remedies applied, a great increase in production can be confidently predicted.

Bunchy-top of bananas

In every agricultural country the losses caused by various diseases of plants are enormous, but methods of mitigating the effects of most of them have been devised by plant pathologists and plant breeders. Effective sprays and dusts are continually being discovered and means of applying them perfected, while the patient and sustained work of plant breeders is frequently rewarded by the production of disease-resistant varieties. Occasionally a new malady appears which baffles their efforts for a time. An excellent example of this is a disease which appeared amongst bananas in north-eastern New South Wales and south-eastern Queensland and reached epidemic proportions in the early twenties, threatening the industry with extinction. It is popularly called bunchy-top because one of the main symptoms is that the new leaves of the plant as they are produced became smaller, more brittle and more upright and later take on a typical rosetted habit. If the plant is attacked early no fruit is produced at all, and, even when infected later, the bunches are small and abnormal and the fruit is generally unsaleable.

When it was discovered that the Cavendish banana grew well on the volcanic slopes of the regions mentioned, an industry of a most desirable kind gradually grew up in the second decade of the present century. It was ideal in that an industrious family could make a comfortable living on an area of from ten to twenty acres and it probably resulted in the production of a greater quantity of food per acre than any other crop. It was considered very suitable for returned soldiers of the 1914-18 war, and many of them were settled on blocks of land in areas suitable for banana-growing. The greatest weakness was the dependence on one crop and one source of income, as land of such high value in such small blocks could not very well be used for any other purpose.

All went well for a time and the production in New South Wales increased from 180,000 cases in 1919 to 460,000 cases in 1922, mainly through an extension of the area under crop. Then came the tragedy, as it was in the latter year that bunchy-top, which had been recorded as early as 1913, reached epidemic proportions.

Few plant diseases in any part of the world have ever wrought such sudden and disastrous havoc to a flourishing industry. Three years later, in 1925, an officer of the New South Wales department of agriculture reported: "Fully ninety per cent of

the area producing bananas in 1922 has gone out of production . . . at least 800 deserted plantations", and all because of this mysterious disease. As things began to get desperate, the growers and their business friends offered a substantial reward for a cure, and about eighty suggestions were sent in—everything from epsom salts to gelignite and planting the corms upside-down, but all absolutely useless.

As events subsequently proved, it would have been better to offer the money for a scientific investigation of the disease. Bunchy-top had actually been recorded in Fiji, Ceylon, the Philippines and Egypt, although it had never done damage comparable with what was happening in Australia. A certain amount of investigation had been carried out by plant pathologists in all of these countries without throwing any light on the nature of the disease.

There were very few trained plant pathologists in either New South Wales or Queensland at the time, and none of them could be spared to devote the whole of his time to the problem. An appeal was made to the Commonwealth institute of science and industry, and an agreement was made, as in the case of prickly pear, for joint financial contributions to an investigation of the problem. The first step was to appoint a committee of three professors early in 1924 to visit the affected area and recommend what steps should be taken. In little more than a week they had presented their report, which was to the effect that it was first necessary to ascertain beyond any doubt the cause of the malady, that the very best available plant pathologist with experience of tropical diseases should be offered a large salary to devote his whole time to the problem, and three names were suggested in order of preference. Cables were sent to them in turn, but none of them was in a position to accept the offer, and the matter was sent back to the committee to get a further recommendation. This was to the effect that the work should be entrusted to a recent graduate in agricultural science of the University of Sydney who had shown special ability in plant pathology, that he should be given a plant-house and laboratory on the spot to carry out his work, which should be overlooked by Professor Goddard of the University of Queensland. He was also to be assisted by a horticulturist, who carried out the field experiments on land leased for the purpose. The young graduate carried out his duties with great efficiency and within a year had got the whole story, namely, that bunchy-top was a virus disease transmitted from

plant to plant by the banana aphid. Now it was possible to take action with full knowledge of what was happening. It seemed hopeless to arrest the disease by killing off all the aphides, as they had many hiding-places, some of them underground, which it would be difficult to reach with a spray. The remedy had to be an extremely drastic one. Every banana plant in the deserted plantations had to be killed off as well as every diseased plant on the farms which had been kept going, as soon as the first symptoms appeared. This is the policy which has been carried out with great thoroughness ever since, the banana-growers themselves providing a large proportion of the funds for the band of trained inspectors who visit every plantation at regular intervals and see to the destruction of any diseased plant. The number of plants affected and destroyed as the result of this rigid inspection has got fewer and fewer as the years have passed. In 1937 the number of bunchy-top plants per 100 acres was 269 whereas in 1951 it was only 15.

The greatest care has also to be taken to ensure that no portion of a diseased stool is used for propagation purposes. With the original drastic destruction it took the industry a few years to reach its former dimensions, but during the last two decades it has gone ahead by leaps and bounds and represents one of the most valuable and productive small-scale industries in the whole of Australia

In 1928-9 the production in New South Wales had got as low as 142,000 bushels, whereas by 1950-1 it exceeded three million bushels.

Of all fruits grown in the Commonwealth in 1950-1, bananas came third to apples and oranges in production and money value. With 23,627 acres under crop, 3¼ million bushels were produced, valued at £4½ million, and the industry, at one time threatened with extinction, provides an interesting and profitable living for nearly 4000 families.

CHAPTER XXXII

Hopes for the Future

AUSTRALIA is sometimes described as an empty continent—a phrase which gives the impression that there are immense areas of unused land awaiting settlement. The actual position is that only 36 per cent of the land of the Commonwealth was unoccupied at the end of 1950. The bulk of this consists of desert or other unproductive land which is incapable of profitable occupation in the present state of our knowledge. Of the remainder, 7.7 per cent has been alienated and is now the property of private individuals or companies, while 1.8 per cent is in process of alienation or is held under a form of tenure which will become freehold when all the conditions are fulfilled. Much the largest area (54.5 per cent) is held under lease from the Crown.

Progress in the future must come from the more intensive use of the land at present occupied rather than from the vast open spaces which have not yet been taken up. On 31st March 1951 the total number of owners, lessees and share-farmers on rural holdings was only 259,000, and their permanent and temporary employees were even smaller in number, namely, 238,000. Subdivision of properties in the more favoured regions is continually going on, although this is counter-balanced to a small extent by the aggregation of holdings, especially in the lower rainfall regions. In few areas has the optimum size of stations or farms for any particular type of enterprise been scientifically worked out, but it is obvious that there is still room for a good deal of subdivision whenever an area at present used purely for grazing has been proved suitable for agriculture or mixed farming or even for intensive pasture improvement.

Attempts have been made in most of the States to define the size of a living area or a home-maintenance area in the principal regions of each. There are districts in Australia where a change of farm enterprise has made an immense difference to the area of land necessary to support a family in reasonable comfort. Owing to the small carrying capacity, 25,000 acres was not too

large for a grazier to make a reasonable living from sheep in one particular region. When the land was found to be reasonably suitable for wheat-growing, 1200 acres were found sufficient. When water was made available for irrigation, a comfortable living could be made on twenty to thirty acres. This is perhaps an extreme case, but it indicates the general trend, especially where irrigated agriculture can be practised. Similarly, when land which was used for beef cattle is found capable of growing intensively cultivated crops like sugar-cane, cotton, tobacco and peanuts, and is used for these purposes, its capacity to support a much larger human population producing goods many times more valuable than when used purely for grazing purposes, is manifest. There are cases, too, in dairying districts where a farmer would do better for himself and for the community if he sold half of his property and utilized the capital thus released for herd improvement, pasture improvement and fodder conservation. With wise and careful management he could then produce as much milk and butter-fat as he was formerly doing on the original area, and give the opportunity for someone else to follow his example on the portion sold. There are many instances, too, where adequate provision for transport by rail and road would make possible the more intensive and profitable use of land. The greatest potential factor of all for the encouragement of closer settlement and increased production is the extension of facilities for irrigation. Skilled management, taking advantage of the accumulated knowledge at present available, could bring about a substantial addition to production on quite a large percentage of occupied holdings. Effective control of the rabbit pest, for instance, would frequently double the carrying capacity, and it is difficult to estimate what new discoveries and new devices and practices might accomplish in the future.

With regard to achievements up to the present, the accelerated rate of general progress in the Commonwealth since federation is illustrated by the following table. These are approximate figures.

The striking increase in population has not been due to a much larger number of people directly engaged in the land industries owing to the greater mechanization of all of them. A notable feature of the first fifty years of the present century in Australia, especially since the first world war, has been the growth and development of manufacturing industries of every description. The number of workers employed in factories increased from 312,000 in 1911 to 989,000 in 1951, nearly double

the number required to produce the huge amount of wealth derived from the rural industries. Many of the factories are engaged in processing products of the land and a still larger number in manufacturing the requirements of graziers, farmers, dairymen and orchardists, like agricultural implements, fertilizers,

	1901	*1951*
Population	3,825,000	8,500,000
Sheep	72,000,000	115,500,000
Cattle	8,500,000	15,500,000
Wool production (lb.)	539,000,000	1,100,000,000
Meat production (tons)	(*a*)	1,000,000
Butter production (tons)	46,000	164,000
Cheese production (tons)	5,300	44,000
Condensed milk and milk powders (tons)	*nil*	104,000
Area under all crops (acres)	8,800,000	20,000,000
Area under wheat (acres)	5,000,000	11,500,000
Production of wheat (bushels)	38,500,000	184,000,000
Area under oats (acres)	461,000	1,757,000
Production of oats (bushels)	9,790,000	25,128,000
Area under sugar-cane (acres)	87,000	397,000
Production of sugar-cane (tons)	1,368,000	7,052,000
Total value of pastoral and dairying production	£37,000,000	£798,000,000
Total value of agricultural production	£23,800,000	£194,000,000
Total value of rural production	£60,800,000	£1,000,000,000

(*a*) *Not available.*

fencing wire and wire netting. About a quarter of a million are engaged in the retail trade and a considerable proportion in wholesale merchandising, mining, building, transport, financial institutions, the professions, the public services, etc. These facts added together help to account for the apparent anomaly that, in what is regarded as a primary producing country, more than half the population is congregated in the capital cities.

Even more satisfactory than the increase in the number of sheep by 43½ million is the greater constancy of these numbers in recent years. There has been much less fluctuation due to variable seasons as the result of continuous advances in such things as pasture improvement and fodder and water conservation. There seems no reason why the flocks should not continue to increase as more and more attention is given to these three factors, and if the promising results with myxomatosis supplemented by other devices should result in the elimination of the rabbit pest, the flocks could be increased by many millions. As

it is, Australia still produces more than a quarter of the world's wool from about one-sixth of the world's sheep. She also supplies more than half of the merino wool, which is in such demand in spite of the growing competition from synthetic fibres. The steady increase in the average weight of fleece, which is about the highest of any country in the world, is another satisfactory feature.

The production of 358,000 tons of mutton and lamb in 1949-50 is also a creditable performance, and this is certain to go on increasing as more and more wheat farmers devote a greater area to fodder crops and temporary pastures in their rotations. If the price of wool should fall, more of our graziers will also doubtless pay greater attention to the dual-purpose sheep in districts suitable for them. The extension of facilities should result in a manifold increase in the carrying capacity of irrigated holdings devoted to the raising of fat lambs, whilst general methods of pasture improvement and the correction of minor element deficiencies should be very potent factors in the same direction. Altogether there seems no reason why the Commonwealth should not strengthen her position as the leading country of the world in the production of wool, mutton and lamb.

The two great branches of the cattle industry—beef production and dairying—are capable of similar expansion. Whilst the production of ever-increasing quantities of cereals is necessary to provide even a bare maintenance diet for the rapidly growing world population, the products and by-products of the cattle industry are certain to remain in constant demand by those inhabitants who can afford a relatively high standard of living. With regard to beef, Australia's growing population is utilizing an increasing proportion of the local production, and unless some calamity happens to reduce the purchasing power of our main oversea customers, a profitable export market seems assured for an indefinite time ahead. As the beef market is a discriminating one, a serious effort will have to be made to improve the quality as well as increase the quantity. More attention is now being given to the breeding aspect of this problem and the nutritional side should be greatly improved by the same factors as are contributing to the advancement of the wool, mutton and fat-lamb industries, namely, pasture improvement and fodder and water conservation. These practices can be more readily applied in the favoured southern half of the continent and the amount as well as the quality of beef production there is likely to improve with more diversified use of the land. Those graziers and farmers

who at present employ only sheep in their livestock husbandry could frequently improve their position in every way by rearing or fattening some beef cattle as well. The resumption of the export of chilled beef should give a fresh fillip to the industry. Because of lack of communications and of knowledge of the best methods of pasture improvement, progress in the vast areas of our tropical north is likely to be slower, but it will come eventually.

As already indicated, the development of the dairying industry has been much more rapid since the eighties of last century than that of the beef-cattle industry, although there is still a preponderance of beef cattle in Australia.

In 1951 the 15½ million total of cattle included 10.7 million beef cattle compared with 4.8 million dairy cattle, the majority of the latter being confined to the better rainfall districts near the coast with increasing numbers on irrigated pastures in the interior. There is perhaps no rural industry which is capable of more rapid increase in production than dairying. A considerable extent of virgin land, especially in Queensland, still awaits clearing for the development of dairy farms. Nearly all the areas at present devoted to the industry could greatly increase their production by more attention to breeding, feeding and general management, as the average production of milk and butter per cow is much below what it ought to be. There is room, too, for a levelling up of the quality of both butter and cheese to nearer the standard of the best. The increasing world demand for the various grades of condensed and concentrated milk and milk powders has opened up new markets for products of the dairying industry since the beginning of the century. With an increased *per capita* consumption of liquid milk by a growing population in Australia itself and a constant demand for good quality butter and cheese there seems little chance of over-production for an indefinite period ahead.

If we take the products mainly derived from our natural and improved pastures, 1000 million pounds of wool, a million tons of meat, 1000 million gallons of milk, partly made into 300 tons of dairy products, to say nothing of all the hides, sheepskins and other products of the pastoral industry in 1951, is not a bad effort for a country which produced none of them 163 years ago. The increase in value of the pastoral and dairying products from £37 million to £798 million in the fifty years since Federation seems colossal but is partly explained by the phenomenal rise in the price of all of them, especially wool, between 1901 and 1951.

The increase from 8.8 million to twenty million acres under crop between 1901 and 1951 hardly tells the whole story. Fallowing was not a common practice at the beginning of the century, whereas in recent years there have, on the average, been about 8.5 million acres under fallow, usually in preparation for a wheat crop. Then whereas at the beginning of the century wheat constituted about eighty per cent of the crop, it occupies only 58.5 per cent of the cultivated area today. Several crops which were not grown at the time of federation have now become successful commercial ventures, like rice, linseed, flax and the grain sorghums. There has also been a big proportionate increase in sugar-cane, orchards, vineyards and vegetables, all of which produce a much higher monetary return per acre and support a very much larger population than wheat. In addition to all that, the area under sown grasses and clovers, which was comparatively small at the beginning of the century, is nearly as great as that occupied by all crops today, and in consequence, 65,000 acres are now devoted to the production of lucerne, clover and grass seed.

Second in importance to wheat, as far as acreage is concerned, come crops grown for green fodder, of which oats, lucerne and wheat are the most important, in that order. Then follow oats for grain, then hay of various kinds and barley for grain. Each of these crops or groups of crops occupies well over a million acres and they are followed by sugar-cane, vegetables, orchards, vineyards, maize, sorghum, linseed and field peas.

Other important crops which occupy a considerable acreage are cotton, tobacco, peanuts, hops, broom-millet, canary seed, and sunflowers, whilst on smaller areas still, some in the experimental stage only, are grown arrowroot, soybeans, mustard, ginger, chicory, vegetable seeds, New Zealand flax and tung oil nuts. On a smaller scale still, some herbs as well as scent and drug plants are grown, and in the neighbourhood of cities and towns the supply of ornamental plants and cut flowers by nurserymen represents a considerable industry.

Wheat is still the pre-eminent crop, and there has been a good deal of speculation regarding the maximum area that could be used for it and the greatest amount of wheat that Australia could ultimately produce. Although 11½ million acres were grown in 1951, that by no means represents the greatest area that has been devoted to it. As a matter of fact it is actually a million acres less than were grown as long ago as 1915, in which exceptional year the production was only five million bushels

less than in 1951. The greatest wheat acreage planted and harvested was in 1930, another exceptional year, when eighteen million acres were grown. The area from then up to the beginning of the second world war varied between twelve and fifteen million acres. For reasons already mentioned the area sown during the war years was reduced to eight or nine million acres per annum, and the average acreage in the last five years has been 12.7 million, or rather less than in pre-war days. Unfortunately the area has tended to decrease slightly in the last few years, although a higher yield per acre has kept the output fairly constant. In five recent years the wheat crop of Australia has exceeded 200 million bushels, the largest production being in 1947, when 220 million bushels were harvested, while the highest average yield of 17.83 bushels was obtained in 1949. Some areas previously used for wheat on the drier fringe have recently been retired from cultivation and rightly used entirely for grazing. Even in the better rainfall districts of the wheat belt greater areas are now being used for fodder crops and pastures for the production of fat lambs and wool, and, as previously explained, this is all to the good for the conservation of the soil and the maintenance of fertility. Taking these facts, as well as the competition of other crops like oats, barley and linseed, into consideration, it has recently been estimated that in the present state of our knowledge it would be possible to grow about 20½ million acres of wheat for grain each year in Australia. This is not very much larger than the acreage in 1930, but a higher average yield could be expected nowadays. Even at fifteen bushels to the acre this would represent an annual production of 307½ million bushels, which is comparable with the average Canadian crop of a few years ago. Costs of production and transport have gone up alarmingly in recent years and the price for local consumption has been maintained at a figure below that in the open market. The export price is still quite profitable, as costs have risen just as much in the United States, Canada and the Argentine, our chief rivals in the export market. What the future trend of prices will be it is impossible to predict, but if they should fall, it will be imperative for our wheat growers to reduce their costs of production and for governments and companies in charge of transport to reduce their costs and fares as well.

Although some figures previously quoted do not appear to corroborate it, oats constitute the second most important crop grown in Australia. Besides its importance as a grain crop

admirably adapted for fodder conservation, it occupies a larger acreage than any other grown for both green feed and hay. The breeding of new varieties suitable to our climatic conditions has been a big factor in its growing popularity. As there seems no possibility of any considerable export trade in oats, this crop is never likely to reach proportions comparable with wheat, but there should be a gradual expansion in its production for the purposes for which it is at present used.

According to the Commonwealth statistician there has been a continuous falling off in the acreage under hay crops of recent years owing to the gradual decline of the horse population. The figures may be misleading, as some of the States do not include hay made from natural or sown pastures, and this is increasing in quantity each year. The average yield per acre of hay made from oats, wheat and lucerne shows a definite upward trend, which is not altogether accounted for by the preponderance of good seasons. The recent improvement in the design of pick-up balers and their more widespread use seems certain to result in increased hay production for conservation purposes as the years go on.

At the beginning of the present century Australia did not produce enough barley for her own requirements, but certain districts, especially in South Australia, were found to produce a very good quality of this grain. Although the yield per acre has not been particularly high the area gradually increased from about 100,000 acres in 1901 to over a million acres today. English brewers like to have a proportion of their barley grown in a warm dry country, and the Australian product has been found to supply this need very well. In consequence, quite a considerable export trade has developed of recent years. In 1950-1 over twelve million bushels were exported, valued at about £9 million, and there seems no reason why this should not gradually increase.

Maize is fourth in importance amongst grain crops in Australia with an area of about 170,000 acres. There has been a slight decline in acreage of recent years. This has been balanced by increased yields per acre, which compare favourably with those in any part of the world. There is much land near the east coast as well as on parts of the tabelands quite well adapted to the growth of this crop, but as Australia only aims at producing enough for local requirements, the area is not likely to increase rapidly, especially as maize-growing has to compete with other industries like dairying and sugar. When we have a sur-

plus a ready market can be found in New Zealand and adjacent parts of the Pacific, but it would usually be better to retain it as a reserve for drought years. On the drier fringe of the maize belt the grain sorghums are being grown to an increasing extent, and there would appear to be great possibilities of a rapid expansion in the area devoted to them.

As previously recorded, rice has proved a profitable crop on a small scale on the Murrumbidgee irrigation area, and should the need arise and a satisfactory price be available, it could grow into a considerable industry in the future when irrigation facilities become available in Queensland and even the Northern Territory and the tropical parts of Western Australia. The two chief objections to it in the southern irrigation areas are the relatively large quantity of water required and the danger that it may cause waterlogging in adjacent horticultural areas.

Altogether there would appear to be opportunities for an increase in the growth of all the cereal grains used for human consumption and for the feeding of livestock.

We have already seen that Australia produces an excess of other food crops like sugar-cane, vegetables and a great variety of fruits. There is abundance of land with suitable soils and adequate rainfall, or irrigation, necessary for a very substantial increase in the production of all of them. Even if it were possible to increase the population to twice its present numbers there is no reason to fear that Australia could not supply all the main items of our food supply with something to spare for countries less favourably situated.

With regard to clothing fibres of vegetable origin, conditions are available for the production of all the cotton and flax likely to be required for local use in the future, although it may be some time before we can do it at competitive prices. At present Australia does very little in the way of producing fibres suitable for the making of ropes, cordage and matting. It has been shown that tropical and semi-tropical fibres like sisal hemp and ramie can actually be grown in certain districts, although it is difficult to see how they could compete with countries with abundant cheap native labour, without the development of effective labour-saving machinery for their growth and the separation of the fibre. New Guinea is a possible future source of these and other tropical fibres. In the cooler temperate regions of good rainfall, hemp and New Zealand flax can likewise be grown, but it remains to be seen whether we can produce the fibre from them as cheaply as it can be imported.

The present position and future prospects of most of the other crops grown in Australia have been discussed in previous chapters and it now remains to make an attempt to estimate the possibilities of future agricultural expansion in the Commonwealth. At present only a little over one per cent (twenty million acres out of 1904 million acres) of the land in Australia is being used for the growth of cultivated crops, and it might be thought that there would therefore be room for an almost indefinite extension of this area. A careful analysis of the position leads to a rather disappointing verdict. Workers at the Waite Institute, using a formula which includes data regarding rainfall and evaporation, have come to the following conclusions:

1. Thirty-four per cent of the continent is either desert or is capable of carrying a very sparse stock population.
2. Forty-two per cent is fitted only for a sparse to moderate population of sheep or cattle, although about five million acres mainly in this region may ultimately be irrigated.
3. Twenty-four per cent, about 464 million acres, has an adequate rainfall for agriculture and intensive stock raising.

Neglecting the irrigated area in the second division, 464 million acres is still a large figure compared with the twenty million acres cultivated today. In the absence of a detailed soil and topographical survey it is impossible to give a precise estimate of the proportion which would be capable of growing cultivated crops. About twenty million acres have to be subtracted for forest reserves, and there is quite a large proportion of the land in this good rainfall area which is either steep and rugged mountainous country or possesses poor sandy soil. The Waite Institute authorities consider that approximately 144 million acres of this could eventually be brought under the plough. If we assume that this land might on the average bear a cultivated crop every third year, that would mean that, in the present state of our knowledge, the maximum area under crop in the future would be about 48 million acres. If to this we add the five million acres of irrigable land, it would give 53 million acres, or just about two and a half times as much as the average area of cropped land in the last decade. It is just as well to note the qualifying phrase, "in the present state of our knowledge", as there is no saying what future agricultural research may do in the way of rendering productive land at present considered too poor to cultivate, as in the case of the Ninety-mile Desert. These figures do emphasize the facts that Australia must rely largely on improved methods for

any rapid increase in the volume of production from the livestock and agricultural industries. Many such improved methods in the past have been due to the initiative, and inventiveness of land-holders themselves, but frequently they have come through the work of officers of departments of agriculture, other government organizations, or research institutions. Every encouragement should be given to the recent move to increase the facilities for carrying the results of research more directly to a larger proportion of our primary producers. Such extension work is not likely to have its maximum effectiveness until greater attention has been given to farm survey and farm management studies, as the land-holder must be convinced that the adoption of new ideas or new techniques will result not only in increased production but in greater profits.

Behind all this extension work it is of the utmost importance that there should be a speeding up of research into the manifold problems which confront the man on the land today.

Our various soil types must be more fully investigated so that deficiencies may be corrected, erosion arrested and fertility maintained. The best techniques must be worked out for the conservation of soil moisture in our drier districts and for the application of irrigation water. Plant diseases and insect pests must be further studied and the most effective methods for their control devised, taking full advantage of the wonderful new group of fungicides and insecticides which science has provided in the last few years. Plant breeders must intensify their patient labours to produce still better varieties of cultivated crops and pasture plants. All the main regions of the globe with similar climatic conditions to those existing in Australia must be diligently searched to find pasture plants and varieties of cultivated crops which might be of direct use or helpful as a source of breeding material. Valuable new weapons for the control of weeds, like hormones and chemical sprays, must receive ever-increasing attention. Further study must be given to the principles underlying the processing and preservation of all kinds of vegetables and fruits and to the complex techniques required in the production of the highest quality wines.

On the animal side further genetical studies are necessary for the more rapid improvement of every class of farm livestock. Greater attention must be paid to the finer points of animal nutrition, so that something approaching the ideal diet may be devised for their nourishment in normal times and during periods of drought. Veterinary research must be still more

diligently pursued in order to devise refinements in methods of preventing and curing diseases of domesticated animals and the destruction of external and internal parasites. New methods of dealing with the rabbit pest must be perfected to supplement the work done by myxomatosis in recent years. More persistent investigation is still necessary to bring about a continuous improvement in the quality of butter, cheese and other dairy products. The best methods of pasture improvement must be worked out for each set of conditions.

These are just a few examples of the types of investigation which have paid excellent dividends in the past and offer still greater possibilities for the future. It follows as a matter of course that there must be a progressive improvement in the facilities for the training of agricultural and veterinary research and extension officers.

The ultimate progress in rural development must come from the man on the land himself, who has done such wonderful work in the 163 years of our short history, and it is only right that he should have all the assistance which agricultural education and research can give, especially as his success benefits, directly or indirectly, every member of the community.